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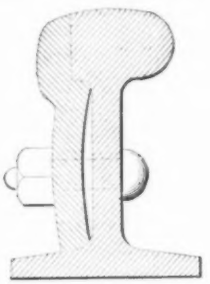
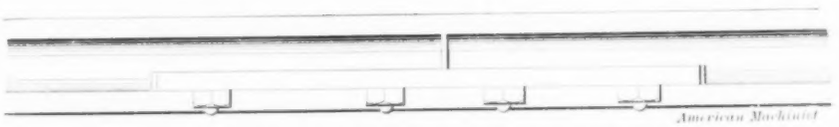
The Place of our Destination—VII.

Editor American Machinist:

When the time comes that one must leave London, and he wants the mean time to do it by, he can get it at Greenwich, just down the river, or go by the South Eastern Railway, and he will get the same thing likely, as the London people set it down as the meanest railway in the kingdom. But there is one thing worthy of imitation; that is, the supplying of the compartments with clear maps of the route over which the train travels.





FISH-PLATE STREET TRAMWAY, DOVER.

The practice is not confined to this road, but I noticed it particularly on this line, perhaps, because of making use of it.

On our way to Dover we turned off to visit Canterbury, perhaps as much for the same reason that we went to Yarmouth as to see the cathedral, which was, to visit the places described in David Copperfield and connected with the life of Dickens.

The cathedral is the largest of the old Gothic ones, and perhaps larger than St. Paul's. While the cathedrals usually have two rows of columns, and rarely four rows, this Canterbury Cathedral has six rows, a great nave and three aisles on each side, being, except in this respect and in size, not specially grander than many of the others.

At Dover I observed a new feature in street railroad (tram) rails. The fish-plates were halved into the rail heads, and so act as to bridge over and prevent the bump at the joints. (See Fig. 1.) It is the most promising scheme I have seen.

A four hours' ride on a fine new steamer lands us at Ostend, in Belgium—a new country to us; but as I had pored over French (which is the language mostly used) some years ago, and as Mrs. Sweet had learned to "read and speak French fluently in five weeks," we have no trouble when there is anyone along to tell us what it is all about. As a matter of fact, three languages are spoken in Belgium—English, French and Flemish. We speak English now, and the rest the other languages.

A short way inland from Ostend is the dead city of Bruges. It seems that cities die like the red-wood trees of California. When a red-wood tree dies, a row of sprouts spring up at the outer fringe of the roots, and when the stump disappears, there stands a circle of trees with a barren center where the original tree stood.

The city of Bruges is a dead place with live villages around its margin. Ghent, further on, is a manufacturing town and a place from where they send shiploads of flowers to New York, and a place about which I may have more to say later. A two hours' ride from Ostend brings us to Brussels, another of the stopping places on our way to the place of our destination. I suppose that if an engineer undertook to arrange our language or system of schooling, he would make about as bad work of it as a linguist would at machine designing; but it would seem to an engineer that children could be taught to either spell or pronounce the names of places as they are spelled and pronounced at the place itself, as easily as they are now taught how to do it in the French or English way. Where is the fun in becoming familiar with Antwerp, and then find before you get there that it is Anvers?

Belgium is cursed with two languages and two systems of measurements. I say cursed, but it may be blessed in the eyes of the advocates of the metric system. Take one item alone—the signs, all of which have to be done twice over. Every shop has to have two sets of measures and gages, a double stock of iron, and I have a notion that this double system adds to, rather than diminishes, the figuring, which is the great and only claim the metric system possesses. The claim made for the universal adoption of a single monetary system proves, in practice, a delusion, for although four or five countries have adopted the universal standard of a franc, when I wanted the change for 100 francs in French money in Brussels, I had to pay the exchange exactly the same as if I had wanted to cash ten dollar gold pieces in England, and the figuring was the same. Of course, the claimants for the metric system say that when it becomes universal, then the trouble will all disappear; but the old can never die out, and the adoption of the new means two systems forever. France, with no fixed national system to begin with, has not, by her laws and a hundred years of experience, been able to wear out the old.

We came to Brussels because of its Universal Exhibition, and find it a beautiful city and a desirable place to stay. Aside from an annex some five miles away, the Exhibition is practically all in one building—not the best arrangement for architectural display, but certainly the best for a sightseer who tires of tramping around.

Two things struck me with surprise—the number of single-cylinder engines and the almost entire absence of dynamos directly connected to engines. Aside from the De Laval turbine, which has on its shaft a 1½-inch pinion running into 15-inch gear wheels and driving two dynamos, I think there is no direct-connected plant on the grounds. The explanation given is, that they have been all through that experience, and have given it up, while with us it is certainly growing universal. My own notion is this, that here the builders build both engines and dyna-

mos, and the whole plant comes cheaper where a high-speed dynamo is used. With us the dynamo builder would quite as soon sell a multipolar dynamo for a large price as a bipolar one for a small, and certainly the direct-connected plant is by far the most desirable. Certainly, the belted plants cannot usually compare with the direct connected. The De Laval is a noisy machine, and with the condenser pump and traps, is neither a simple nor an altogether ideal rig.

There is quite a variety of engines, the drift being in the direction of Corliss engines with valves in the cylinder heads, or other valve motions with the valves in the heads. It seems to be well understood here that the economy comes from reducing the clearance surface and making what surface there is as smooth as possible, and as to valve motions they all amount to about the same thing, one builder using an enormous amount of traps to accomplish the desired end and others going straight at it.

One which it seems to me will prove a freak I will describe, because it shows an ingenious way of doing what it seems to me does not want to be done. It is one of the schemes to make a high speed engine that shall resemble a Corliss engine. It starts with a fixed eccentric to operate the exhaust valves, all of which are of the oscillating or Corliss, or James Watt type. The steam valves are operated by the ordinary link motion, with a very powerful Porter governor to operate the link. The rod from the link block operates a wrist plate, which so far is all straight enough, but instead of the valve rods operating as in the Corliss arrangement to have the valves at rest when under pressure, these rods have quadrants forged on them to engage in pinions on the valve stems, which so far as I could see just exactly neutralized the effect the wrist plate is designed to accomplish. One engine of the Westinghouse and Willans type, built at Ghent I believe, and naturally calculated for high speed, is belted to the dynamo instead of direct connected.

When we first arrived, very little in the engine exhibit was in a finished condition, although the exhibition had been open nearly a month, but the two weeks we have been here now show such marvelous progress that the display will soon be creditable at least. Things in state of erection always look shabby, as has been the case with all the machine tools, but as they begin to clean them up they bring out a nice finish that is to be admired. One French company has a large variety of machine tools of, I fancy, borrowed designs, showing finer workmanship than any of our American exhibitors, though likely there are not a half dozen in the lot that one of our machine tool builders would take as a gift. When a machine has a single feature about it that is like our own we call it American, and the builder does also, though it may have a dozen things about it that we ourselves borrowed from the English, as of course we have borrowed about everything except minor details. Using Vs on a lathe bed for the carriage and tail stock stamps a lathe as American, though it may have nothing else like ours about it. They call the vertical boring mill American, though Bodmer built such a machine a quarter of a century before it was first built in America. It may, however, be right to call it American for our tool builders have persisted in making it a machine built by machine tool builders and sold to others.

The most of the best tool builders in Europe do not use the machine much, because they do not think it is as good or does as good work as the pit lathe. They have to admit economy in time of setting, but they never lay as much stress on that as we do. There must be some reason why the best European engineers do not like the boring mill that is not sound or can be overcome. Either the mills have not been accurate or strong enough, or they do not use them as intended. The cause of pulleys and wheels being out of true is far more likely to be the springing in setting than defects in the machine, and the boring mill gives the best possible chance to warp a piece out of true. If the only way to finish a pulley true is to first bore it and then turn it on a mandrel, then the boring mill should have a way to hold mandrels. In dealing with crowning pulleys, the two heads for turning the two tapers without changing is an advantage, in addition to that due to working two tools. On small boring mills the true way to hold pulleys is by three dogs clamping three arms. On larger machines a side head, such as used on the 30-foot mill at the Union Iron Works, San Francisco, is right. Aside from a small machine by the Bullard Machine Tool Company, I think there is no boring mill shown, nor is there any such show of vertical milling machines as that at Paris eight years ago.

JOHN E. SWEET.

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The Metric System in Use.

Capt. H. R. Sankey, who is a director of the Willans & Robinson Company, of Rugby, England, has read a paper before the Institution of Civil Engineers, in which he gives the results of the experience of his company in the use of the metric system of measurements. It seems that some sizes of the Willans engine are still made by the English system of measurements, while others are made to the metric system; so that the two systems are used together in the same shop. The result is that the metric system is much the better liked, and is considered best and most convenient both for the drafting room and for the shop. Capt. Sankey's paper gives the facts and the reasons in full.

A Manuscript Factory.

The growth of technical journalism has developed a new industry, which may be called, for lack of a better name, manuscript manufacture. In New England there seems to be a factory which makes a specialty of this, and which has sent us numerous samples of its product, which, upon being returned to the factory as worthless, have afterwards appeared in the columns of some of our esteemed contemporaries as very pretentious articles. The products of this factory show how much can be attained in that direction by one who knows practically nothing of the subject of which he writes, but knows how to exhibit his ignorance in attractive sketches and glittering generalities which either mean nothing at all or simply repeat statements of facts known to every tyro. The articles are, however, well calculated to deceive an editor not overloaded with knowledge of mechanical matters, and they probably look well

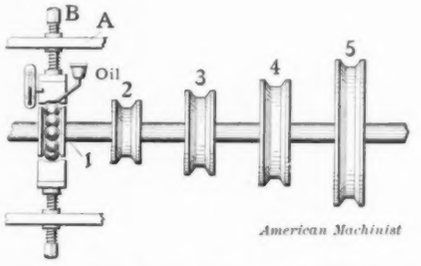

Fig. 5. TESTS OF DIFFERENT SIZED BALL BEARINGS ON SAME SHAFT.

enough to a business man who knows little or nothing of mechanical engineering, but may be considering an advertising contract.

We give a sample extract from a recent publication of this kind. It is taken from an article which, superficially glanced at, looks well; but when examined is found to be of absolutely no technical value whatever. We quote as follows:

"In order to ascertain some definite facts concerning the relation of the diameter of grooved ball bearings to their efficiency, I put five bearings of different diameters on one shaft, as illustrated in Fig. 5.

"Size 1 is shown in sections, and the fixings attached were the same for the other four sizes. Undue pressure was obtained at will by screwing down the set screw *B* in the cross-bar *A*. This was to see the results of excess of weight on the balls.

"No. 1 was 8-inch diameter; No. 2, 12-inch; No. 3, 16-inch; No. 4, 20-inch, and No. 5, 24-inch. Speed of shaft 220 per minute. By allowing the oil in each to run dry and screwing down the cases unduly, the temperature-recording instruments attached to each bearing showed that No. 1 was first to heat, followed by Nos. 2, 3, 4 and 5 successively; the smaller bearings were also first to grind, thus illustrating the advantage of bearings of

liberal diameters, in which the pressure is distributed over more surface and among a larger number of balls."

We are thus informed that tests have been made to prove that large bearings will stand more weight upon them than small ones will, and this sort of information is presented as though it really was something of importance not hitherto understood. The rest of the article is of about equal importance, and the same may be said of all the others which are the product of this manuscript factory.

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Centering.

BY A. H. CLEAVES.

In Fig. 1 I show a method for getting eccentric centers on the end of a plain round rod, supposed to be of the same diameter the whole length. Where the work is not particular the centers can be laid out with a surface gage, the rod being laid on a plane surface and held in one position until marked off with cross lines. But drilling to prick-punch marks on a long or heavy piece is not a very certain process, and the following I consider an improvement where accuracy is desirable.

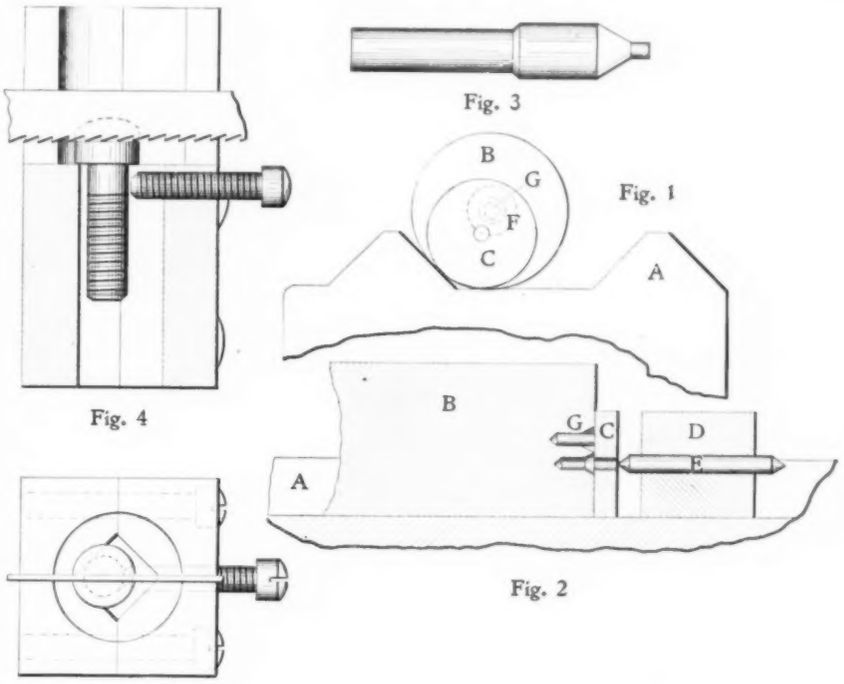
Take a piece of metal larger than required, like *D*, round of course. Make a hole in the center for the mandrel or arbor *E*, having male centers on each end. Have *D* long enough to admit of dogging the work end for end, so as to turn true the whole length. On *B* the circle *F*, Fig. 1, has been obtained in any way thought best, and shows the distance of the eccentric center from the true one to be secured in this way. Turn *D* off on the outside, upon *E* running in hollow centers, until the point of *E*, placed as shown by *C*, Fig. 1, will coincide with the circle *F* in the same figure.

Let *A* represent the ways of an engine-lathe, or a similar receptacle with a straight angle. Then hold *B* in the corner of the angle, as shown, until two pieces *C*, cut off of *D*, are held in the same angle against *B* and soldered in position, as shown in Fig. 1. These two pieces at opposite ends of *B* furnish a positive guide or jig for drilling the eccentric holes. These can be countersunk with a guide-end countersink, Fig. 3, after removing *C* from *B*. In Fig. 2 *G* is a plug with small true center for laying off the circle *F*, Fig. 1; and used after *B* has been turned off and faced up on the ends. The centers should be drilled and countersunk with tool shown in Fig. 3.

TOOLS FOR CENTERING SCREWS TO BE SLOTTED, ETC.

Such a tool is shown in Figs 4 and 5, and will be found convenient for slitting any kind of round work as well. This makes a quite useful accompaniment to a hacksaw, and hardly requires a description, as the drawings explain themselves.

Figs 6—10, however, for the same and other uses, may be described. In Fig. 6 *B* is the T-rest post on a speed lathe, with a saw-slot and tightening screw *O*. The post *P* carries a table rest with one cross slide. *P* is threaded and has a nut *C* for adjusting the table up and down. *H* is a knurled handle with smallest diameter graduated on the rim. *I* is a stud with index finger, as shown, pointing to graduated rim of *H*. This is fixed in the upper slide of the table-rest, and the groove in the same allows the screw *Q* to work in it and move the top slide. This screw has a square end shouldered to be held in the handle *H* by the screw *R*. *D* is a square holder with stop screw in a swinging piece *R*, Fig. 7, which drops down to strike the slide piece *A* for a stop when *D* is turned over. *S* and *E* are stop-screws for *D*.



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In Fig. 8 *K* is a counterbore being milled on the sides with a rotary file *J*, and *E* would stop the work, *K* as it is shown in the sketch, while *S* would stop it at *U*. Inside and outside stops.

Fig. 9 shows counterbore held in *D* being slabbed off on two sides between two cutters; and Fig. 11 shows square-head screws, etc., as milled on four sides by giving *D* a quarter turn. *D* has a hole for wire *F*, being ¼ inch or any convenient size in diameter; and used for screw holders like *F*, counterbores like *M*, etc., etc. Screws are slotted readily in this way; and small flat drills quickly milled on the sides.

G shows holder similar to *D*, but six sided, and is indispensable in dressing small taps. Three of the sides of this holder are used for this purpose, and taps ground three sided in this way, leaving small surface on the tops of the thread, are strong and very nice working. They do just as good work and do not break as readily as very small fluted, after being hardened and tempered, taps. The taps are ground on the edge of an emery-wheel.

Fig. 10, *H* shows a cheap yet useful clamp, and different sized, round pieces, *T* can be held with this as shown in Fig. 10 or without it as in Fig. 6. A variety of milling operations with table as shown, and also at right-angle from such position, can be performed by the use of clamps in Fig. 10. Sawing into side of rod or sinking end mill into same; holding arbor for cutter being revolved while backing off teeth, flat or concave, etc., etc.

I have found tools like these not only a good substitute for a milling machine if not in a shop, also preferable to rigging up and getting work into a regular machine; and more convenient in any event than a large machine. In Fig. 7 *W* is a screw fitting closely in *F*, which can be set in any position for headless screws to bottom against so as to slot them alike, and not have them enter the holder too far.

One of the useful features of a table-rest that might be mentioned is the advantage it affords for squaring up the edges of work against an emery wheel, or an iron face-plate with emery cloth waxed onto its surface. Emery cloth cut in a circular form about eight inches in diameter is sold now by the dealers for this purpose. Make two light face plates for a speed lathe, warm them over a gas-stove, if there is one in the shop, or in any way for that matter. Rub a cake of bees-wax on the plates, and when melted rub the backs of emery-cloth upon the plates until charged with wax. Then with

a coarse grade on one plate, and fine one on the other, for variety, clamp the two plates face to face with cloth between until cool. Take a little pains in fixing them and they will stay until used up, and the amount of work they will do is quite surprising.

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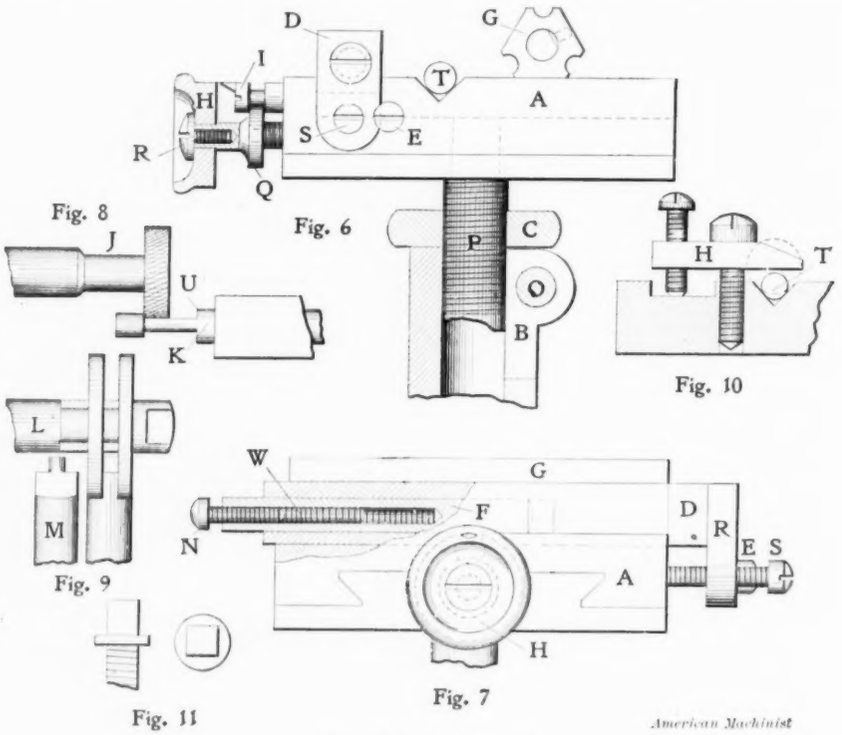
English Lathes.

The larger the shop, the better can the machine tools be arranged for the performance of special tasks, with corresponding economy of time and wages, and improvement in results. Hence, in shops of small and medium dimensions, the combined sliding, surfacing and screw-cutting lathes must of necessity fulfil by



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turns the functions of plain turning between centers, of turning on the faceplate of work swung in the gap, and of screw-cutting. The class of work done fluctuates so much that it is impossible to keep each lathe strictly to the class of job for which it was primarily adopted. On a single lathe, in the course of a week, a man may turn shafts and pulleys, bore wheels and bearings, cut screws (both short and long), and turn tapered and bellied outlines, having to effect correspondingly numerous changes in the mechanism. This takes time and initiative scheming. But as the dimensions of shops increase, lathes with specially long beds, without gaps and without screw-cutting gear, will be kept for turning shafts, axles and similar jobs. Lathes with short beds and gaps will be reserved for chucked work. Lathes with lead screws, but without backshaft, will be used for screw-cutting only or mainly, and each class of lathe will be grouped in one section of the shop under a sub-foreman, and the men and lads who operate them would be very much at sea if put on lathes of another type.

The following tables will indicate very approximately the capacities of the ordinary self-acting sliding, surfacing and screw-cutting lathes:

* * * * * *

The relation of weight to dimensions in machine tools is a point of so much importance that many firms make a point of stating the weights of machines of certain dimensions. Mass, when properly distributed, tends to increase in stability, with consequent increase in capacity for removing weight of metal.

The introduction and growing employment of steel in the form of both castings and forgings has had its effect on lathe construction, so that some makers construct lathes of special strength for turning steel work. The reasons why stouter machines are, as a rule, required for cutting steel than for cutting iron are two in number. First, steel is harder than iron; second, it is often desirable that larger quantities of steel than of iron shall be removed in the same time. The reason for the latter is this, that dimensions are not, as a rule, worked to so closely in steel as in iron, and the surfaces of castings are rougher in steel than in iron; hence the desirability of removing larger quantities of the harder material in a given time.

Mr. Perkins says it takes twice the power to work soft steel that it does to work wrought iron. So that retaining the old lighter machines designed for working on iron, and using them on steel, means doubling the cost of production. If, however, the heavier machines which are now constructed to meet the demands created by the extensive employment of steel are substituted, the time occupied will be no more than that spent on iron. There is the cost of machines, however, to be set off against this. Then everything depends on the volume of trade done.

TABLE I.

Particulars of Self-Acting Sliding, Surfacing and Screw-Cutting Lathes (Messrs. Wm. Muir and Co., Manchester).

Swing.	Length of Bed.	Admits Between Centers.	Admits in Gap. In Dia.	Admits in Gap. From Front of Faceplate.
in.	ft. in.	ft. in.	ft. in.	in.
10	5 0	3 0	1 8	5
12	6 0	3 7	2 0	6
14	7 0	4 1	2 4	7
16	8 0	4 7	2 8	8
18	9 0	5 0	3 0	9
20	10 0	5 5	3 4	10
24	12 0	6 8	4 0	12
28	14 0	7 10	4 8	14
32	16 0	—	5 4	16
36	18 0	10 2	6 0	18

TABLE II.

Particulars of Self-Acting Sliding, Surfacing and Screw-Cutting Lathes (Messrs. James Archdale and Co., Birmingham).

Swing.	Length of Bed.	Admits Between Centers.	Admits in Gap. In Dia	Admits in Gap. From Front of Faceplate.	Approximate Weight.
in.	ft. in.	ft. in.	ft. in.	in.	Pounds.
12	6 0	3 0	1 10	7	1,680
16	8 0	4 0	2 5	10	3,920
20	10 0	5 6	3 2	12	7,280
24	12 0	6 6	4 0	16	8,960
28	14 0	8 0	4 0	16	11,200
32	16 0	9 0	4 6	18	14,560

Messrs. Smith & Coventry make a special class of heavy lathes for turning steel. The relations between these and the ordinary lathes is best seen by a comparison of weights:

Thus a 12-inch light lathe weighs 96 cwt., a 12-inch heavy lathe weighs 124 cwt., a 7-inch light lathe weighs 25 cwt., a 7-inch heavy lathe weighs 33 cwt. Messrs. Whitworth also supply both light and heavy lathes to the same pattern.

Tables I and II will show clearly the limitation of the standard lathe. It is not perfect either as a shaft-turning machine or as a chucking lathe, being limited both in length of bed for the first, and in size of gap for the second. The first depart-

ures, then, which we may note in a kind of natural sequence are the extension of its utility for the economical turning of

TABLE III.

Comparative Weights of Heavy and Light Gap Lathes (Messrs. Smith and Coventry, Salford).

Swing.	Length of Bed.	Admit Between Centers.		Weight.	
		Light.	Heavy.	Light.	Heavy.
in	ft. in	ft in	ft. in.	lbs.	lbs.
12	6 0	3 6	2 9	1,960	2,464
14	10 0	6 9	6 6	2,800	3,920
16	12 0	8 6	7 9	4,144	4,928
18	15 0	10 9	10 6	5,376	7,500
24	20 0	15 0	14 3	10,752	13,888

long pieces of work of relatively small diameters, and afterwards its extension for the turning and boring of short jobs of relatively large diameters.—Joseph Horner, in "Mechanical World," London.

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Selecting Pine for Pattern-Making.

BY JOHN M. RICHARDSON.

This wood stands at the head for patterns, being employed universally for all sizes. Of course cherry and mahogany are better; but owing to their comparative cost, are used only in a limited way on quite small work, and for trimming exposed parts of larger standard patterns which are in constant use. Pine is soft and easy to fashion into any shape with edge tools. It is light, and does not have that open, coarse grain that chestnut, ash, oak, and some other woods have, and while it is soft, still it is not brittle and liable to easily chip and sliver on exposed parts. Again it does not have that wonderful tendency to curl and twist, as for instance does white wood.

Ordinarily the grain of pine is straight, and it can be planed with satisfaction. This is a feature of no small moment; for what is more exasperating than to try to plane a piece of wood like lignum-vitae, where the grain runs in narrow stripes, as the plane slides along, every alternate stripe being as smooth and shining as glass, while the intermediate ones are very much the reverse; then when we turn the piece around and plane in the opposite direction we get a result exactly vice versa, the rough stripes being smooth, and the smooth ones rough. Every wood has its place, fortunately, and lignum vitae works beautifully in the lathe. Another reason which brings pine into favor, and perhaps it is the mightiest of them all, is that it is cheap and plenty. No one can tell any quicker at sight how a given board will work under the tools than the pattern maker who must use it. For this very reason the selection of pattern stock should be entrusted to an experienced person and not left to the tender mercies of the help in the lumber yard. There are certain undesirable qualities in some pine, which we do not want for pattern work, and which can be, for the most part, avoided by a little care; but it is very difficult to do this when the board is rough before being planed at the mill. It is better, I think, to buy the stock planed, for one can then see what he is getting. A shaky piece is to be avoided as useless. This is where the grain seems to be cracked and slivered lengthwise of the board. It is claimed by some to be caused by the wind straining the tree, and sometimes by the way the tree falls when it is felled. I am not an authority as to the cause, however, but realize fully the undesirable effect. Knots are an objection which is self evident, and can be easily avoided, because in plain sight. What is termed sap wood is undesirable, also. This is found toward the outside of the tree, next to the bark, and sometimes an outer board near where the slab was removed, will show sap pretty nearly all over one side, and show scarcely any on the other, except at the edges. Many good boards are sappy at the edges. This is probably the least of the undesirable qualities, and is shown by the color which is usually almost white, although sometimes of a darker shade. In these places the wood seems lifeless and spongy, and is very difficult to work smooth with the tools.

A soft board which works easily is very light, and one would not associate the word pitch with it in any sense. It is also lighter in color, while a hard piece is much heavier, and traces of pitch being clearly seen, while the whole is more yellow in color. A hard piece works very much the nicest in the lathe, and will turn up very smooth indeed, but is not so pleasant to use with hand tools.

Above all things get dry lumber, for no matter how perfect the quality, if not properly seasoned and dried, it will shrink and crack, and cause no end of trouble and spoil the finest of patterns.

Many pattern makers prefer season dried stock to kiln dried. This is open to opinion like other things, but it must be thoroughly dried in some way. When a piece of plank is sawed off it will check at the freshly sawed ends after a time if not properly dried. If it shows any inclination at all to check at the ends, it is not properly seasoned, and not fit to find a place in a pattern.

In storing away lumber ready for use, it is bad practice to pile boards flat, one above the other, for this allows no circulation of air between. Either pile edgewise, or flat, with narrow splines placed at intervals between.

Some pine shows curious short curved streaks which seem to bear some analogy to the marks in quartered oak. If anything, these marks are a little harder than the surrounding wood, and are frequently found in the best lumber and a board having them is not therefore necessarily to be avoided; but the ideal stock for a pattern is light, soft and straight grained, free from all knots, sap, or any irregular markings whatever, and last, but not least, dry, and this last to be emphasized.

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Machinery Trade in Great Britain.

Matheson & Grant, of London, in their "Engineering Trades Report," have the following to say of present conditions in Great Britain:

"Mechanical engineers, ironfounders and machine-tool makers include so great a variety of trades, that no general statemen can apply; but, broadly, all are busy at fairly remunerative prices. There has been a lull in the great demand for mining machinery, partly owing to the uncertainties in South Africa; but the development of gold and other mining ventures in many other parts of the world is likely to steady the average demand on which manufacturers depend. Electric haulage in mines and on tramways, and electrical transmission of power for machines and cranes in factories, are becoming more widely adopted, and have the greater effect on the industries concerned, because Great Britain has much leeway to make up as compared with other countries. Gas-engines are taking a more important position, partly due to the facility with which those of larger power than formerly can be constructed, and partly also to improvements in the manufacture of cheap gaseous fuel. The manufacturers of machinery for the textile trades are busy, as also are those who make plant and machinery for steel and chemical works. The extension of cycle-making factories seems to have reached its culminating point, both in Europe and America, and the increased output has already had the effect of reducing prices. Machine tool makers have met the increased demands upon them by new designs, giving greater working power and less friction. The application of electric motors to machine tools and other improvements in form and method have retained in the country a branch of engineering, which is subject to serious and growing competition from American manufacturers.

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An extra edition of "Brown and White," the college newspaper of Lehigh University, has been issued, for the purpose of setting forth in full the facts connected with Lehigh's recent troubles. It has been rumored that the university would be compelled to close its doors, owing to the serious curtailment of its regular income; but the immediate needs of the institution have been provided for by an appropriation of $150,000 by the State of Pennsylvania, and it is expected that there will be no further serious difficulty. In fact, it is reasonably hoped that the publicity given to the university and its work by this apparent calamity may eventually result in permanently improved conditions.

Best Paint for Iron and Steel.*

From our present knowledge, the following system for painting iron and steel bridges and other metallic structures is recommended:

First. Give the iron and steel a coat of the best grade of refined linseed oil, properly boiled and settled clear; or, still better, mix linseed oil with about 10 per cent. of a good grade of lampblack; this coat to be applied at the mills, the iron or steel being first carefully cleaned from loose scales.

Second. After the structures have been erected, give them one coat of real asphaltic varnish paint, made from the best grade of asphalt, linseed oil and gum, compounded properly, so as to form a true varnish; or of a paint made from carbon black and a properly boiled varnish, compounded of the best grade of linseed oil and gum. This coat should be carefully applied by a skillful painter, after the metal has been thoroughly cleaned from all loose scale, rust, shavings, filings, shrivelled oil or paint, grease, dirt or any foreign matter, because it is of the utmost importance that the paint should be spread and worked in such a way as to cover the surface properly, and be as free as possible from air bubbles and form a continuous coating. This priming or first coat should be applied fairly thick, the thickness depending, to some extent, on the nature of the paint used. Before the second coat is applied, the first one should be thoroughly dried and hardened by natural oxidation, which will require at least ten days. If practicable, it would be a great deal better, as well as more economical, to apply the second coat not less than four weeks after the first one.

Third. As a second coat, a good grade of graphite paint is to be applied as thickly as possible, working the paint thoroughly with the brush. From the examinations made of the various grades of graphite paints, as far as graphitic pigments are concerned, there appears to be but little difference between them, provided, of course, that the pigment contains at least 33 per cent. of pure graphite, the rest of the pigment being natural rock, ground very fine in pure linseed oil. The graphite paint should be bought in paste form, well ground, and contain not less than 70 per cent. of pigment and 30 per cent., by weight, of the best quality of boiled linseed oil; the paste should be mixed with boiled linseed oil at the place where it is to be applied. No turpentine, no benzine, and no Japan or driers should, under any circumstances, be allowed in this paint.

The system just described, if properly carried out, will give a protective coating which will last for many years, and it is firmly believed that this system of painting (provided that the paints are of the best quality) will protect iron and steel for a longer period than any other system now in vogue.

Fourth. There are certain parts of steel or iron bridges, viaducts or tunnels that should have an additional (third) coat of paint. These include such places, or parts of structures, as are directly exposed to the steam, fumes and gases from passing engines. For such a coat some cheaper asphalt paints, applied very thickly over the coats above recommended, would be all-sufficient. Such a coat would protect the underlying primary coats for many years, preserving their natural toughness and elasticity, and preventing atmospheric action on the structure.

In the past, red lead was largely, if not exclusively, used as a paint for iron and steel structures, but within the last ten years it has been to a great extent discarded by progressive engineers and builders. It is true that we to-day have advocates of red lead as the best paint. Still, the fact that these so-called red-lead men now begin to add carbon black or graphite to their paint, is a sure sign that they themselves no longer believe red lead alone to be the best pigment.

Fifteen years ago or more iron oxide men appeared and flooded the country with their various grades and qualities of iron-oxide paint, as being the paint which nature itself had provided for the protection of steel and iron structures against rust and corrosion. From the investigations made, as well as from practical experiments, it appears that the iron-oxide paints are not very desirable, at least for the first coat or two, for iron or steel; but, as a third coat, for the protection of the underlying paints, they may be recommended.

However, the extensive investigation of graphite paints that can be obtained in the markets to-day shows that, if properly applied, they are far superior to iron-oxide paints for the second or third coat, especially as they withstand the action of moisture and water much better than the best iron-oxide paint so far examined. Besides, a graphite paint, in paste form, well ground and mixed with boiled linseed oil, will not cost very much more per gallon than the cheapest iron-oxide paint in the market.

In recommending asphalt varnish paint or carbon paint for the first coat, great stress is laid upon the necessity of having the surfaces of iron or steel as free from moisture as possible while the structures are being painted, otherwise there is great danger that the coating will not adhere very firmly, and that it will thus actually nullify the value of the paint. This precaution is less important when an ordinary iron-oxide paint or red-lead paint, simply mixed with linseed oil, is used; because linseed oil itself has the property of absorbing moisture quite readily, whereas carbon or asphalt paint will not. The lack of this property in the two last-named paints is one of the principal reasons why they are superior to any other.

Although it is proper that true economy should always be exercised, preference should not be given to any paints whose properties lie simply in the fact that small quantities of them cover great areas. Often the first question asked is: "How many square feet can you cover with a gallon of your paint?" cheapness being considered the most important factor. Of course, the greater the number of feet that can be covered with one gallon of paint the thinner will be the protecting coat. There is a limit beyond which it is inadvisable to carry this. Other things being equal, the paint that can be spread over a fairly good area should be considered superior to any which goes to the extreme either way.

* Abstract from a paper by Max Toltz, read before the Civil Engineers' Society of St Paul, Minn., December 7, 1896.

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Steel Material Used in the Construction of Naval Vessels.

Some time since, the attention of the Committee on Naval Affairs was called by the then acting Secretary of the Navy, Wm. McAdoo, to the second section of the Act, entitled, "An Act to increase the naval establishment," which was approved on August 3, 1886, and which provided: "That the vessels hereinbefore authorized to be constructed shall be built of steel of domestic manufacture, having a tensile strength of not less than sixty thousand pounds per square inch, and an elongation in eight inches of not less than twenty-five per centum."

At the time of the passage of this Act, steel possessing the qualities prescribed therein was considered best adapted to all the uses of shipbuilding. But within the last ten years, and particularly within the latter half of that period, great progress has been made both in naval architecture and in steel making, and what was in 1886 the hight of art in those branches, is in 1897 more or less antiquated.

The development of steel manufacture at the present time is very rapid, and nickel and other alloys of steel are beginning to emerge from the experimental stage, and may, within a short time, show such a high efficiency as to be very desirable for extensive and general use in the structure of ships. Consequently, any set of specifications of characteristics of steel drawn now might be practically obsolete in a year or so, and it is clearly very unwise that the department should be restricted in the selection of that kind of material which may be most suitable for the purpose intended.

Under the Act above mentioned, the requirement for a tensile strength of 60,000 pounds, with 25 per cent. elongation, narrowed the kind of steel to one quality. It was necessary, therefore, to use this one kind of steel for all structural parts of battleships as well as of torpedo boats, whereas very much better results might have been obtained if the characteristics of the material could have been graded to

meet the requirements of each part of the structure. Thus in some parts of a ship high tensile strength and small elongation are necessary, and in other parts a low tensile strength and much greater elongation give the best results. Torpedo-boat steel should also be of a different quality from battleship steel, owing to the different characteristics of the two types of vessel, but under the present law it has had to be all of one kind.

The Assistant Secretary called attention to the fact that it was greatly disadvantageous to the government's interests that the requirements for the steel for naval vessels should be fixed by an Act of Congress, which is necessarily somewhat inflexible, and for that reason would be ill adapted to the varying conditions of the day, which require that the department shall be able to exercise discretion in deciding upon the characteristics of steel for the several kinds of vessels, and for the different parts thereof, in order that the best results may be obtained in the construction of the same, and he recommended a provision for insertion in the naval appropriation bill, as follows: "That in the construction of all naval vessels, the steel material used shall be of the quality and the characteristics best adapted to its purpose, in accordance with specifications approved by the Secretary of the Navy."

In the last of March another letter on the subject was received by the Committee on Naval Affairs from Secretary of the Navy Long, calling attention to the previous letter of the late assistant secretary, and adding thereto the suggestion, that in every vessel there is a large percentage of steel material of the hull which is not essential to the strength of the ship, such as coal-bunkers, ash-chutes, coal-chutes, hatch coamings, water-tanks and doors. These can be made of a comparatively inferior, and therefore much cheaper, material without lessening in any way the strength or efficiency of the vessel. Again, where vessels are built for certain special purposes, with great structural strength to withstand high engine power, and yet with a light weight of hull to reduce to the minimum the displacement, such as high-speed torpedo boats and torpedo catchers, it is desirable to employ steel of a very high grade; for instance, of 80,000 pounds tensile strength, or more, and with steel of this high strength it is not possible or necessary to obtain an elongation of 25 per cent. in 8 inches.

Other cases might be cited in which variation from the requirements which steel material must possess in order to be used to the best advantage in the construction of naval vessels, is desirable.

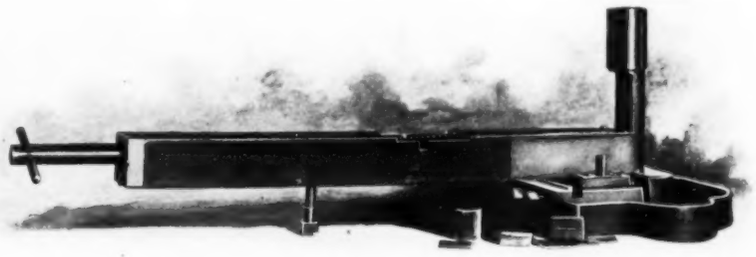

Fig. 1. A PRESS JOB.

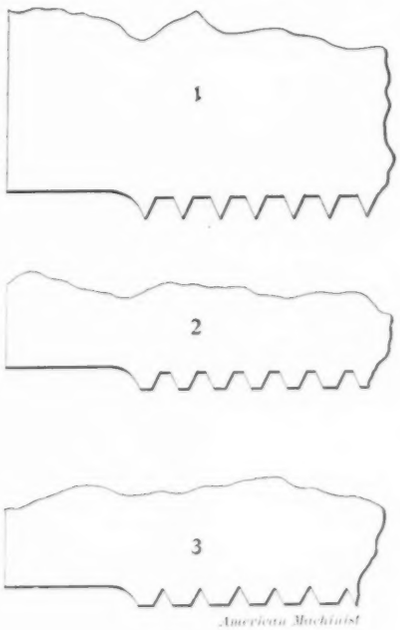

Fig. 3

A Press Job.

BY W. A. WARMAN.

In a handle-bar clamp which we are making it was necessary to have a corrugated ferrule in halves. The corrugations were fine and on the outside of the ferule. We made the half ferules flat first, and, after corrugating, bent them to the half circle. We milled quite a quantity, getting out quite comfortably 600 per day on a No. 2 Kempsmith mill. The quantity was not nearly sufficient for our requirements. We had in the basement a press with a 5-inch stroke, and we decided to try that. The press product, while not as smooth as the milled one, held the bar and did not look very bad.

The photograph Fig. 1 shows the magazine for feeding the blanks and the assembled die with the punch in position. One of the corrugated flat plates stands against the corner of the die holder. It has a slot in the middle of it. Fig. 2 shows the parts more in detail. We made our first die with four cutters out of a solid piece. Of course we followed the old and reverenced traditions, and made it like a thread-cutting die. It did not work. Every time we tried to harden it the two rows of teeth in the center crowned. Then it did not leave the tops of the teeth on the ferrule smooth. It then began to dawn upon us that we did not need a perfect V-thread, so we reversed the order of things and made a die for our job regardless of our hallowed traditions.

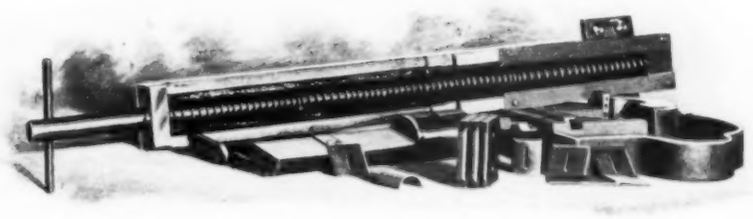

Fig. 2. DETAILS OF PUNCH, DIES, ETC.

The die was made in three pieces held in alignment by two taper pins. The first cutter took out a narrow V-groove to the full depth, leaving the top of the teeth flat. Cutters two and three did no cutting, except to bring the tops of the teeth to a sharp edge.

The feed magazine shown in the detail photograph holds about 200 blanks, and gave us no trouble. The rim shown on the die bed was designed to take care of the oil, but "you'd ought to seen her." When we had our pump speeded up sufficiently to get rid of the chips, we had to cover the whole thing in and put an iron pan under the die bed. I feel that our success with this job was largely due to the lubrication, or flooding with oil. We

used a Brown & Sharpe pump speeded to 1,200.

Fig. 3 in the sketch shows the cutter teeth outlines considerably exaggerated, and the teeth on each succeeding cutter being shorter and the angle more obtuse. Fig. 4 shows the positions of the cutters. Fig. 2 shows the oil holes at the left of the punch guide. The oil was supplied to these branch openings through a hole in the die bed connecting with the pump. The punch was made of machinery steel, slabbed off to the center through its work-

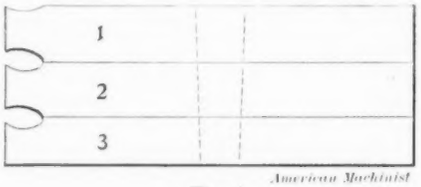

Fig. 4

ing length and offset. A piece of hardened steel, dovetailed in at the shoulder, engages the blank at the outlet of the magazine at each stroke. Two set-screws with lock nuts at the rear of the die block furnish adjustment. A longer stroke and more cutters, I presume, would give much better results.

Buffalo, N. Y.

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Transmission of Power by Compressed Air.*

The gratifying results obtained in the use of compressed air for operating locomotives and shop machinery, and the high efficiency that could be obtained in a properly designed plant for the general transmission of power, led the author of this paper to believe that such a plant could be successfully operated in the city of Pittsburg.

In a fireproof building situated on the banks of one of our rivers, and as near the business portion of the city as possible, will be installed the necessary boilers and air compressors. Water for feeding boilers and cooling purposes will be pumped from the river, thereby saving water tax. Coal will be received by rail or boat, and handled by machinery. Ashes will also be handled by machinery, and loaded into boats or cars as required. Boilers will be of the water tube type, fitted with mechanical stokers, and capable of developing 2,000 indicated horse-power in the steam cylinders of the compressors. There will be two air compressors, with triple-expansion condensing engines of the Corliss type, having steam cylinders 20, 34, and 50 inches diameter, by 42 inches stroke. The air cylinders will be compound, two for low pressure, each 26 inches diameter and one for high pressure, 30 inches diameter; all 42 inches stroke. The air will be taken at atmospheric pressure through a cooling apparatus, and specially adapted Corliss valves into the two low-pressure cylinders, and discharged through an inter-cooler, into the one high pressure cylinder; the air will there be compressed to 100 pounds per square inch, and delivered through a cooler into the pipe line. Each compressor will be capable of delivering about 6,000 cubic feet of free air per minute, compressed to 100 pounds per square inch gage pressure. The compressor will be fitted with automatic valves which will reduce their speed when the pressure in the pipe line runs up to a little more than 100 pounds per square inch and speed them up again when the pressure falls. It might, however, be advisable to subdivide the compressing machinery into three or more units to facilitate repairing and lessen the liability of seriously crippling the plant in case of accident, or break down. The two larger units as here described are from an estimate kindly furnished for this paper by the Norwalk Iron Works Company. There is no necessity for large storage tanks or reservoirs, as the mains provide sufficient capacity to permit the air to be pumped directly into them. Moisture will be withdrawn from the mains by suitably arranged traps and delivered into the sewers.

The main pipe line from the power house will consist of 12-inch wrought-iron pipe coupled together by bolted flanges. It will extend to where the next work of street distributing mains begins, and will there be reduced in size as the carrying capacity and frictional resistance of each branch of pipe permits. The street distributing mains will consist of 6-inch and 8-inch wrought-iron pipe coupled together by threaded sockets. No expansion joints will be required.

In estimating the cost of construction it has been assumed that the power station could be located within 8,000 feet of Eleventh or Grant streets, and allowance has been made for that length of 12-inch main. Provision has been made for laying pipes on all the principal streets of Pittsburg, situated between the Monongahela and Allegheny rivers and on and below Grant and Elizabeth streets. Stop valves enclosed in suitable street boxes will be provided at frequent intervals in the mains, by means of which the air supply can be shut off from any section of pipe undergoing repairs, or while service connections are being made. The estimate does not cover the cost of service connections, as they will be paid for by the consumers of the power, but does cover the cost of meters. Liberal margin has been allowed in the various items, and the following figures would undoubtedly cover the actual cost of construction. Allowance has been made for dividing the boilers and compressors into such units as to provide reserve power, available in case of accident or while repairs are being made.

COST OF CONSTRUCTION.

Real estate	$ 30,000 00
Buildings	20,000 00
Compressors erected on foundations with condensers and attachments	55,000 00
Boilers	21,000 00
Stack and britchen	3,750 00
Mechanical stokers	4,375 00
Circulating and feed pumps, injectors, etc	4,000 00
Cooling apparatus	2,000 00
Water tanks	1,500 00
Coal and ash conveyors	4,000 00
Pipe lines and distributing mains	70,000 00
Meters	5,000 00
Engineering and expenses of organization	25,000 00
Miscellaneous items, including electric light plant and crane for power station	10,000 00
Contingencies	19,375 00
Total cost of plant	$275,000 00

COST OF OPERATION PER ANNUM.

Interest on investment of $275,000.00 @ 6 per cent	$ 16,500 00
Deterioration 4 per cent. of $275,000.00	11,000 00
Taxes	3,500 00
Fuel	5,000 00
Salaries and wages	16,500 00
Repairs and supplies	5,000 00
Office expense	2,500 00
Total annual cost of operation	$60,000 00

It is estimated that the plant will deliver 1,100 horse-power for 3,000 hours and 200 horse-power for 5,760 hours per annum, or a total of 4,452,000 horse-power hours per annum. The annual cost of operation, divided by 4,452,000 gives 1.35 cents per horse-power per hour, or $40.50 per horse-power per annum of 3,000 hours. The cost of power to consumers would be graded somewhat according to the amount used. This would not be a hardship to small users of power, because to such consumers the power would be cheap at any reasonable price. To users of power in moderate quantities, the cost per horse-power per annum, including attendance, cost of heating and interest on cost of motors and heaters would not be more than $50.

For deterioration, there will be laid aside each year out of the earnings, 4 per cent. of the total investment, and this money placed at 3 per cent. compound interest will, in about 19 years, equal the capital invested or sufficient to rebuild the plant entire. It will be noted that the cost of operation would increase but slightly with considerable increase in the capacity of the plant, and also that the cost of construction would not increase in direct proportion to such enlargement of the plant. If the building of a larger plant would be justified, the cost of power to consumers would be less than given.

To compare the cost at which power

* From a paper read before the Engineers' Society of Western Pennsylvania, by Richard Hirsch.

could be furnished by compressed air with the cost as furnished by other means, I extract the following from our proceedings, being estimates given in papers read by members of this society at different times:

Amount per horse-power per annum paid to the city of Pittsburg for operating hydraulic elevators, (about)	$700 00
Cost of power per horse-power per annum in a large store having its plant, 15 hours service	128 44
Cost in same plant corrected for 10 hours service	89 92
Estimated cost per horse-power per annum at which power could be furnished by a proposed hydraulic power company, with no allowance made in operating expenses, for taxes or deterioration of plant	77 70
Cost in same plant corrected for above omissions	100 00
Estimated cost per horse-power annum at which power could be furnished by an electric power company capable of delivering 20,000 horse-power	50 00

The low cost at which power can be furnished by compressed air can only be approached by electricity working under the most favorable conditions. The rates paid for power to the electric companies in Pittsburg at the present time are excessive.

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The High Side of a Pulley.

BY REPAIRMAN.

Jack was up the ladder with wrench in hand, shifting the lathe counter-shaft so the belt would run right. Bill said he guessed that "that was the wrong way." Jack asked him, with much scorn in his voice, if he (Bill) didn't know that a belt would run to the high side of the pulley. Bill said: "Not to any such high side as you can put on with a monkey wrench."

The "Century Dictionary" says in defining "Crowning pulley": A pulley having a convex rim, much used where from various causes belts are in danger of slipping off—the centrifugal force keeping the belt on the convexity. In "Shop Talk" we can hear that a belt will run to the "high side" of a pulley. By "high side" is sometimes meant *a* a diameter greater than any other diameter of the same pulley, and sometimes *b* a point in the rim that is, owing to the shafts not being parallel, farther from the companion shaft than any other point in the same pulley. High side *a* can be put on with a lathe, while high side *b* can be put on, usually, with a monkey wrench. These three notions have been doing duty for a very long time, if we consider that two of them have no foundation of fact to rest on. The third is true only under certain conditions. High side *b* repels a belt instead of attracting it, and centrifugal force, if any exists tending to shift the belt laterally on the pulley, is so infinitesimal in value as to be of no consequence whatever. High side *a* will, if the shafts are parallel, attract the belt, but if they are not parallel, its influence may be neutralized or increased, depending on the direction of convergence of the shafts. If we consider that a belt, however wide, may be bent edgeways, and that every point in it, when approaching a pulley, will try to travel in a path parallel to the general plane of rotation of the pulley, we will have all the facts needed for any case that may come up. In Fig. 1 the belt *A* is wrapped around the cylindrical pulley diagonally, with a long end hanging down and carrying a big weight fixed to the middle point of the width of the belt. With the shaft horizontal, and the belt nailed fast to the pulley, so it can't slip, the hanging end will be plumb, or parallel to the general plane of rotation of the pulley when it revolves. When the pulley is turned each point in the belt will try to travel in a path parallel to that plane, and, as the hanging end is by supposition already in such a path, the belt will wind up fair, coil on coil, or will "run true," or will not "creep or climb" along the pulley. Belt *B* has the weight fixed to one corner, and the belt being extensible, edge *F* is stretched and becomes convex. Point p is moved to p_2, which is in the plane of rotation of p_2, which lies at some distance from p_4. When the pulley is turned under these conditions, the belt will not wind up "fair," or will not "run true," or will "creep or climb" along the pulley.

Belts do not often have big weights fixed to them, but they do have big pulls to withstand which are quite as effective as a weight would be to stretch one edge more than the other if the pulleys are so made, or placed, as to put the unequal tensions in. In Fig. 2 the pulleys are cylinders and the shafts not parallel. Point p is in the plane of rotation of p_2 and will go there. Point p_3 is in the plane of p_4, but will not go there, as a new condition will come in when the

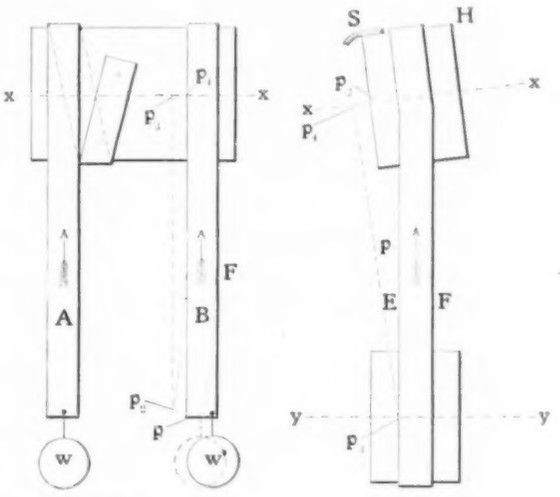

Fig. 1 Fig. 2 Fig. 2A

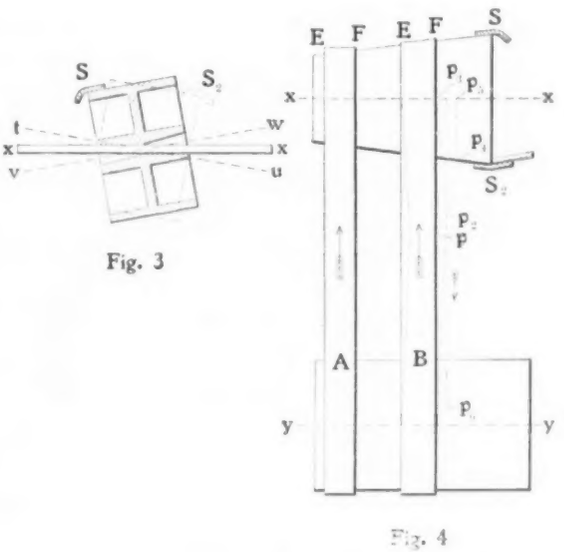

Fig. 3 Fig. 4 Fig. 4A

VARIOUS KINDS OF "HIGH SIDES."

belt begins to hang over the edge of the pulley. Hanging over, it will curl in as at S, which will relieve the tension in edge E. As the tension in F remains, the belt will be bent as in Fig. 2 A. When this bending carries the point p to the plane of rotation of p_2, the running requirements will be satisfied and the belt will go no further to the left unless it slips off.

Belts running in this way may be seen in almost any shop. The cause may be lack of parallelism of shafts, slightly taper pulleys, or the hanger supports yielding to the pull of the belts. It may be due to another cause peculiar to loose pulleys. When a loose pulley wears in the bore it is usually in an hour glass form (Fig. 3). A pulley so worn may tip over and revolve around the axis V W. Then the belt will hang over as at S. If it happens to tip the other way, the belt will hang over at S_2, and the axis will be t u. In Fig. 4 one pulley is a cylinder and the other a frustum of a cone. The shafts are parallel. If belt A be inextensible it will have line contact only with the taper pulley at F. There would be no tending to move either up or down the taper surface except that due to sliding down hill. Belt B, being an ordinary one, hugs the taper pulley by both edges and the extra tension in edge F, due to the large circumference under that edge, bends the belt from the position as shown by the full lines to the position shown by the dotted lines. Point p moves to p_2 which is in the plane of rotation of p_3. Nevertheless p_2 will not go to p_3, for another condition comes in. The large circumference under F not only calls for more belt than is required for the circumference under E, when the belt is standing, but continues to call for more and more when the belt is running. p_2 instead of going to p_3 goes to p_4, which is in the plane of rotation of p_5 and not in that of p_3, towards which it started. While this is going on the return part of the belt coinciding with p_2 in the advancing part tries to travel to p_6 in the cylindrical pulley.

The belt will therefore travel along both pulleys, until some other condition occurs. This will happen when the belt has gone far enough to begin to hang over the edge at S. As the "hang over" and the "curl in" releases the tension in F, the two tensions come nearer to being equal, and when they are equal the running requirements will be satisfied. If before the belt gets over the edge an equal pulley be brought up, base to base, the belt will be prevented from curling in so quickly as at S, but will be supported as at S_2. If the taper is very small, a small overhang at s will equalize the tensions, but one-hali of the belt must pass the joint at S_2 to accomplish the same result whatever the taper may be. In Fig. 2 the belt wanders towards the converging ends of the shafts, and in Fig 4 towards the large diameter of the pulley. These two tendencies may be made to work together or in opposition. In Fig. 4, A, the small diameter of the taper pulley is towards the converging ends of the shafts and the tendencies are opposed. If the angle of the shafts be made to just suit the taper of the pulley the tendency in the belt to travel towards the converging ends of the shafts will be balanced by the tendency to travel towards the large diameter, and the running requirements will be satisfied. In the figure, a and b are the two kinds of high sides spoken of in the shops acting together, at the same spot where the dictionary maker supposes the centrifugal force to be developed, and yet all three together won't make the belt lead that way if the angle of the shafts is just right. This compensating adjustment is used thousands of times and not thought of once. Straight pulleys are generally taper, or else have a hard spot in one edge that did not get turned quite down to size. The conditions under which countershafts are put are not generally conducive to great accuracy in alignment. When the belt is tried and found not to run right, it is always assumed that the shafts are not parallel. Then some shifting of the shaft, one way or the other, often both ways, is resorted to. Finally, when the belt does run right, it is considered sufficient proof that the shafts are parallel.

Probably in two cases out of three, exact parallelism of the shafts is just what is not wanted, owing to faults in the pulleys.

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A Round Level.

The half-tone shows a novelty in the shape of a round pocket level made by E. G. Smith, Columbia, Pa. There is a nickeled metal case and a glass slightly curved, like a watch cystal, enclosing alcohol or other liquid with a free moving bubble. A central tit is left in the bottom of the liquid receptacle, and, looking vertically down on the level this tit will appear in the center of the bubble when the surface tried is perfectly level. If the surface is not level, the positon of the bubble will show the precise direction of the incline, the bubble moving freely in every direction, instead of in a single straight line as with the common spirit level.

The Limitations of Government in Water-Power Plants.

BY MARK A. REPLOGLE, ENGINEER.

The regulation of the speed of a water-wheel in a power plant is determined by four distinct factors:

1. Changes in load or requirements of power;

2. Time required for gravity to generate power;

3. Capacity of the plant for stored energy; and

4. The governor or mechanism that should automatically combine the above three factors in such a manner as to obtain even speed or good regulation.

The word "government" refers to the regularity of motion or speed that is so desirable and necessary in manufacturing and electrical-power plants. Absolutely uniform speed can be maintained only when there is no change in the power supply and no change in the friction or work of the plant; but if the above factors are carefully considered and judiciously manipulated or applied, the variations of speed may be so reduced that the results can be called perfect government.

The speed of a plant at all times is a resultant of opposing forces establishing an equilibrium or balance. The power supply has a tendency to increase speed, and the work has a tendency to decrease it.

Since it is impossible for any automatic governor to change the power supply at the instant a change has been made in the load or work of a power plant, it is very plain that there must be fluctuations in the speed. The problem of government is to narrow these fluctuations to such an extent that the speed will be constant, as far as practical operation is concerned. The finest government ever obtained consisted of changes in speed, but within narrow limits. The speed of a well-governed single-crank engine changes four times every revolution.

The first factor in governing, "the changes in load," is a variable one, and is limited only by the character of the work done by the water-wheel. The changes may range from zero to the full power of the wheel instantly, making government a more difficult problem than it would be if the changes were limited in number or quantity. It is plain that if an even speed is retained when a change in load is made, there must be at the same instant a corresponding change in the power supply. This is an impossibility in automatic governing, for several reasons; the speed must change in order to inspire the speed governor; following this, the speed governor causes the valve or gate-moving mechanism to operate, which operation requires time; and, again, it requires time for gravity to overcome the inertia of the increased quantity of water that must pass through the wheel before an increase in power can be had. During all this time, the speed of plant has been decreasing if

the load was increased, or increasing if the load was decreased, and the amount of change in speed depends entirely upon what ratio the change in load bears to the stored energy in the moving parts of the plant. A heavy change in load will, of course, cause a greater change in speed before the power supply is changed than a light change in load. The problem is, therefore, to proportion properly the power-storage to the changes of load that must be imposed upon the plant, because this power-storage, or the capacity to store power, must take care of all changes in load until the power supply, or gravity effects, can compensate for said changes.

The second factor, "time required for gravity to generate power," is more constant than the first. In fact, the limits are established in the construction of the water-power plant, and, of course, remain so. The point we wish to emphasize most in the time requirements is the inertia and momentum effects of the water.

A locomotive can propel a train of cars at a rapid speed; but it takes time to acquire such speed. When the locomotive has brought enough pressure to bear upon the train, it moves, at first slowly, but keeps increasing in speed often many seconds before it reaches full motion. The locomotive may be limited in strength to 250 horse-power per second. The train in full motion may represent 25,000 horse-power for a second. In such case, it will take the locomotive 100 seconds to bring the train to speed if we do not consider the frictional losses. Water has no power in itself; but must be put in motion by gravity in the same manner that the locomotive starts the train of cars, and a long train of water acted upon by a constant gravity effect, is put in motion in the same manner that the train of cars is by the locomotive. It is plain, then, that the time element must be considered in the government of water-power. The water-wheel cannot furnish power until it brings to rest the water to which gravity has given motion, and it can receive no power from the water until the water has sufficient motion for the moving wheel to retard. It is also plain that there must be changes in the flow and velocity of water for every change made in the load of the water-wheel; also the change in the flow of water must occur before there can be a change in the power supply.

It is well known that water has practically no elasticity; hence, if enclosed in a long pipe, the whole body must be put in motion at the same time. If the pipe or flume consists of several hundred feet of horizontal length and only a few feet of vertical pipe or "head" which alone gives gravity effects on the wheel, it is a similar proposition to the locomotive and train of cars. It is very evident, then, that long horizontal pipes should be avoided in order to reduce to a minimum the time required to get gravity effects, because the speed of water-wheels will keep changing, after a change in load, until the effects from gravity can correct it in the power supply.

Gravity effects at best are very slow as compared with steam, and for this reason a water-power is handicapped in the matter of government. The logical conclusion is, that in water-powers the water or power supply should all be under the direct action of gravity and move in line with it. This reduces the time necessary to furnish increased or decreased power, to the shortest limit.

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High-Speed Attachment for Drill Presses.

We illustrate herewith a high-speed attachment designed for use in any drill press. The device consists essentially of a box or casing containing four hardened steel gears, one of which is cut directly upon the end of the taper shank projecting through and above the box; another is cut midway in the length of the spindle carrying the drill chuck, the upper end of which spindle fits in the end of the taper shank; while the two remaining gears act merely as the back gears of a lathe, except that, in this case, they increase, instead of decreasing, the speed imparted to the driven gears. To use the attachment, the taper shank is merely inserted in the spindle of a drill press like any ordinary drill, the machine started, and the spindle fed down as usual. For each revolution of the drill press spindle, the attachment spindle makes something over two revolutions, giving, in even the largest presses, a suitable speed for drills down to $\frac{1}{8}$ inch diameter.

As ordinarily designed, the larger drill presses in common use are not adapted for drills less than about $\frac{3}{8}$ inch diameter, to the manifest loss of time when drilling oil or other small holes. By the use of this attachment a heavy press is converted into a sensitive drill, and its productive power for light work thereby correspondingly increased.

HIGH-SPEED ATTACHMENT FOR DRILLING.

For small work which is held by the hand while drilling in an upright machine, the rod, shown in the foreground in the cut, is screwed into the end of the handle of the attachment, and rests against the frame of the machine to keep the box from revolving with the spindle; but for large work, in which the weight is sufficient to prevent its being revolved by the drill, and it is not essential to have both hands free at all times, this rod is unnecessary, as a touch of the finger is sufficient to prevent rotation of the box.

The device is made by the Bickford Drill & Tool Company, Cincinnati, O.

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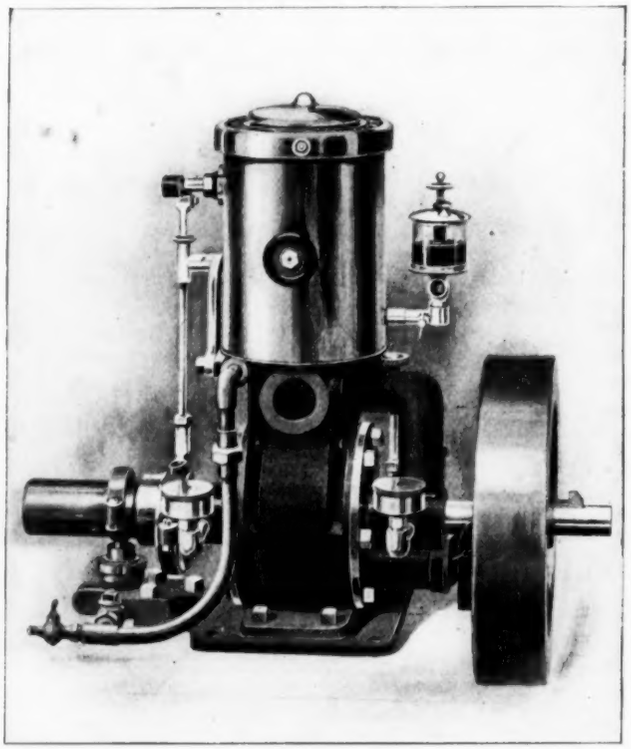
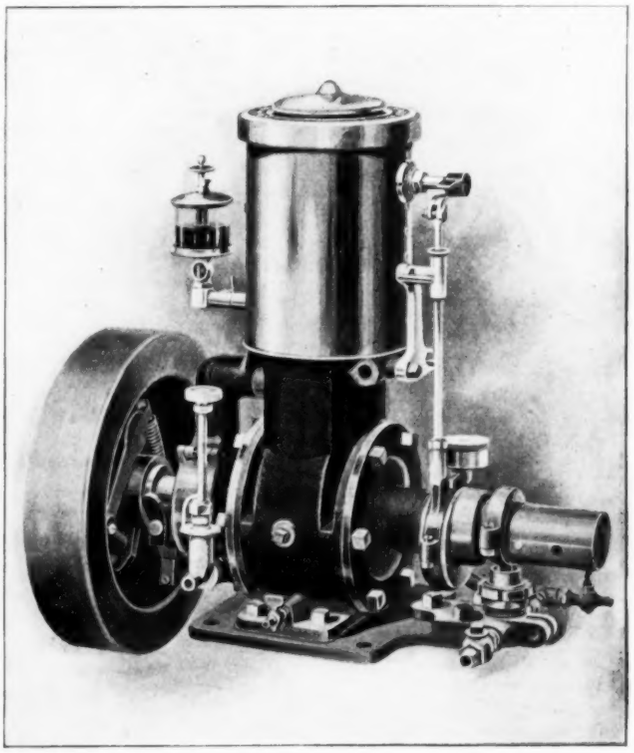
The Cleveland Machine Screw Co. made and sold 234,000,000 steel balls during the past year. These were principally for bicycles but were used for many other purposes.

A Gasoline Marine Engine.

The half-tones show both sides of an interesting gasoline engine for boat propulsion built by the Grand Rapids Gas Engine and Yacht Company, Grand Rapids, Mich. The engine is of what is termed the two-cycle type, although it is not clear why it should not be called a single-cycle engine, as the complete cycle of operations is comprised in a single revolution of the crank or in a single stroke and return of the piston, the crank also receiving its driving impulse at each revolution.





A GASOLINE MARINE ENGINE.

Beginning at the most convenient point of the cycle, there first occurs an admission of air and gasoline to the crank chamber, as the piston is moving upward. On the return stroke of the piston this charge is compressed to a certain extent in the crank chamber, and when the piston has nearly reached its lower terminus a port is uncovered which allows this mixed charge to rush into the chamber above the piston. On the next upstroke of the piston a fresh charge of air and gasoline is drawn into the crank chamber, and at the same time the piston is compressing the previous charge in the chamber above it. When the ascending piston has reached the top and the pressure of the explosive mixture is at its highest, the charge is ignited by an electric spark. When the piston has nearly reached the lower end of the stroke, a port then opened allows the expanded charge to escape, and the opening of the passage connecting with the crank shaft chamber also allows the new charge to rush in, completing the expulsion of the previous charge, and so on the cycle continues indefinitely, the operation being similar to that employed in many other engines.

The means or arrangements by which these operations are accomplished and controlled are, however, many of them original with the present engine. The cylinder has a cast water jacket, and a small pump operated by an eccentric on the shaft circulates the water. Outside the cast water jacket is an air jacket, formed by an outer shell of polished sheet metal seated practically tight at the bottom, and the air used by the engine passes through this jacket. A cap or cover composed of two parts is attached to the cylinder head with a space between. A pipe or air duct, shown just inside the fly-wheel, conveys the air to the vaporizer just below the crank shaft. Immediately below the shaft is a poppet inlet valve, which at the proper time is drawn in by the vacuum in the crank-shaft chamber, and the air rushes in. A gasoline valve is connected with the air-inlet valve and moves at the same time, so that the air gages the gasoline. A needle valve is adjusted by the operator to deliver the quantity of oil judged to be required. This oil first flows into a well, so that the supply will not be affected by either the pitching or rocking of the boat. A small pet cock is placed at the base of the engine, so that if there is an excess of gasoline it can be blown out.

The igniting apparatus is actuated by a vertical eccentric rod, which moves in a pivoted slide near its upper end, so that the top moves in an egg-shaped path, or it has a combined vertical and horizontal movement. This dual movement is taken advantage of to first lift up and bring into contact two electrodes, and then to have the dog on the end of this rod slip off to allow the electrode spring on the movable electrode to force a separation of the two. A single spring is used instead of two or more, as generally employed. The movable electrode is seated in the main cylinder by means by a sleeve having its inner end taper and fitted into a corresponding seat in the inner wall of the cylinder. A shoulder near its outer end forms a seat against which a nut that it threaded into the outer wall of the cylinder engages, thereby forcing it into adjusted position and holding it rigidly.

A governor is shown in the balance wheel. This consists of a single weighted arm with spring and collar around the hub of the wheel, and an arm projecting from the collar with an angular slot fitting one arm of the weighted lever. The movement of the lever slides the collar, and this acts upon mechanism by which the inlet valve is restricted or closed, thereby limiting the charge that can be taken into the crank chamber. The small hand-wheel on the starboard side of the cylinder, above the exhaust opening, is a relief cock for allowing the compression to be reduced. It has a seat on the inner wall of the cylinder, and when opened allows a portion of the charge to escape into the exhaust. There are no pipes on the engine, either for inlet or outlet water or for hot air, the omission of which is a decided improvement in the appearance of the engine.

One effect of the coincidence of depressed business conditions here and good business conditions abroad is shown in the fact that the tide of immigration is at present lower than it has been at any previous time since the general government assumed jurisdiction of immigration in 1882. The number of arrivals from all foreign countries was, during the last fiscal year, 230,832, which is 112,435 less than for the previous year. Italy furnished the greatest number of immigrants, though even here there was a decrease of over 8,000 from last year. We received something less than 10,000 immigrants from England during the last year.

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A correspondent wishes to get an instrument capable of recording fluctuations of steam or air pressure occurring as often as four to six thousand times per minute. Anyone who knows of such an instrument will confer a favor by communicating with this office.

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Letters from Practical Men.

Daubing Up a Cupola Taphole.

Editor American Machinist:

There is a big difference in the manner in which iron comes from a well-daubed cupola, compared with that from one not done in a proper manner. This applies to the tapping-out hole more particularly than to the lining of the cupola.

The usual manner of building up the tap hole is to put a stick in the flow spout, then pack around the stick with clay and sand, and tamp it hard enough to make it stand the pressure of the iron. A way I have seen practiced in some of the foundries in Eastern New York, is to mix up a pail of core sand out of fine loam, instead of the coarse stuff necessary for cores, then put a piece of ¾-inch steam pipe in the spout.

But I like to begin farther back than this. After the cupola is daubed up and the fire started, put a big lump of coal in the opening through the shell of the cupola, and when the fire gets to going inside, it will set the coal on fire and heat the iron around the spout, so that the sand will bake quick. After putting the pipe in, be sure that it goes clear through into the fire, for if it does not, there will not be a clear passage beyond the end of the pipe. Poke the sand clear in onto the fire, and poke it in with a stick, for it is apt to be pretty hot in there for the fingers. Be sure that the sand is well tamped at the beginning, then throw in a couple of double handfuls and take a small rammer to it. Then be sure and make a solid job, or there will be trouble before the bottom drops.

Throw in a handful of the prepared sand, and tamp; then more sand, and tamp again, and so continue until the hole is solid full, even with the outside of the cupola shell. Then, with a very narrow-pointed trowel, scoop out the face of the sand, and shape the hole back about 3 inches, leaving a conical hole around the piece of pipe. That should have been kept moving, by turning it occasionally, and pulling it forward as far as it will come every time a handful of sand is put into the hole.

The pipe cannot be pulled right out, as the inner end is expanded by heat making it larger than the rest of the pipe, but pull it gradually, and it will come out, leaving a good clean tap-hole that is strong enough to hold the iron.

JAMES F. HOBART.

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Broaching Babbitted Bearings.

Editor American Machinist:

"Quirk's" supposition that the babbitted gears, when broached as described in your issue of June 24th, cannot be very accurate, is indeed a supposition only, and should be regarded as such. As a matter of fact, the bearings broached were in every respect of unquestionable superiority to those obtained by other methods; i. e., in accuracy, cost as a whole and in the time of production. It is true the gears in question do not belong to such high class of work as mathematical instruments; however, the machines of which the gears are parts are a little more refined than wheel-barrows. For the sake of curiosity, I will describe some of the methods followed by someone else in the endeavor to produce the same, or, if possible, better, work than by means of broaches such as I alluded to in the description of June 24th. First it was supposed that better and quicker work could be done by boring and reaming, disregarding the expansion of the babbitt metal. The consequence was that the arbor would not drive the work in subsequent operations, and when the arbor was large enough to drive these gears, the holes were about 1-64 inch too large and had to be re-babbitted. Second trial: A broach was made somewhat on the lines as described, but, amongst other variations, the expander was not so abrupt as I used. In consequence of this, and some guessing, the gears were babbitted three times, and the broach (as there are no put-on tools invented yet) was made smaller, but more closely resembling mine. The gears were bored and reamed afterwards at additional expense. All of the babbitted gears, without any exception, are running upon ground shafts, which fact may give an idea of the quality of the work. The possible inconsistency of cast gears and ground shafts does not belong here, nor am I at liberty to make further remarks; the main and principal subject being the finished bearing. As regards the crookedness supposed by "Quirk," I cannot see how this could be produced, as the broach is guided throughout the whole procedure for at least three-fourths of the length of hub; which itself, from the nature of the work, is of decidedly liberal dimensions.

Coming now to the expander, consisting of the roll attached to a mandrel, which is first class for some work, I wonder whether "Quirk" really believes that it is capable of compressing the metal in proportion to its thickness; as it would be if the core for the metal were eccentric with the gear—a condition that is very apt to occur nine times in ten; besides this there is the additional cost of chucking (truing up by the hole), the boring and the final reaming; all of these operations being superseded by a simple passing through of the two broaches, which may be done by any laborer.

The gears so treated, if intended for the highest class of machinery where absolute perfection is imperative, will satisfy the conditions fully and in every respect, and, in fact, if the broaching be performed first, the gears can be turned, polished and finally the teeth cut, and the babbitt metal will stand the pressure of the arbor without suffering in the least or the hole losing its size. The running play of the gears, whose diameters were from 14 to 16 inches, was .005 inch, which, when its comparatively high speed be considered, is very close indeed.

E. LAWRENZ.

Troy, N. Y.

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Ancient Statue Molding Methods.

Editor American Machinist:

An article in your issue of August 5, 1897, under the heading, "That Pattern Making Wrinkle," describes the method pursued by the Japanese in casting metals. The Greeks and Romans worked a similar, though improved process for casting their statues of bronze and other metals, which has not been improved upon to this day.

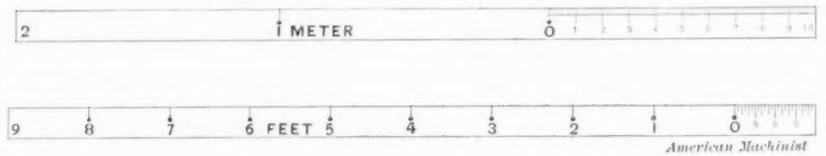
If a statue was to be cast, the figure was roughly modelled in clay—only smaller in dimensions than the finished casting—then covered with wax and worked to the required form and finish. A mixture of brick, clay and ashes ground in water to the consistency of cream, was then applied with a brush, in successive coats, forming a second skin fitting into every line and depression. Soft clay was then laid on in considerable thickness to strengthen the mold, around which hoops of iron were bound to hold the whole together; it was then thoroughly dried and placed in a hot oven, which baked the clay and melted the wax, which flowed through holes provided therefor, leaving a hollow space into which the metal was poured. The core was kept in position by wire driven through the mold into the core before drying. After cooling the outer mold was broken and the core taken out, through holes, leaving the casting, sometimes a mere shell, ready for cutting off the wires which held the core in place, and finishing.

E. H. TOR.

A Metric Compromise.

Editor American Machinist:

The United States is now the only country not using the metric system. It has just been adopted in Mexico, and while in Russia the system is not yet legalized, it is much used through the influence of the French and German engineers. Whether one is in favor of the system or not, some concession must be made in doing business with those who are accustomed to metric measurements. Having made a great many plans for Russia and Austria-Hungary, I have hit upon the following compromise between the English and metric systems: Wherever the dimensions appear upon the plan they may be figured both in metric and English, but where the dimensions are not indicated, two scales are provided, as shown in the sketch; one being the usual scale of feet and inches, the other a special metric scale constructed by laying off 39.37 inches of the scale to which the plan is made, as ½ inch per foot, and dividing this distance into 100 parts. This scale will then represent a meter at the proportion of ½ inch to a foot, and any dimensions may be taken off from the main plan with dividers and compared with either of these scales, so that it is possible to read the plan either in feet and inches or in meters and decimeters.



American Machinist

W. H. SARGENT.

[We should think Mr. Sargent's opening statement is a mistaken one. We use the metric system in this country to a much greater extent than is commonly supposed to be the case, and its use is permitted here by law; i. e., it is a legally recognized standard. It is not used in England much, if any, more than here.—Ed.]

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A Magnetic Instrument for the Shop Eye Doctor.

Editor American Machinist:

I wonder if any of the shop eye-doctors who are contributers to and readers of the "American Machinist" have ever tried a magnetic instrument in their kit of eye tools. The instrument can be easily made. Take a piece of steel, about 5 inches long and ½ inch in diameter; draw one end out into any desired shape, leaving most of the stock for a handle. Draw the temper of the thin part to a light blue, leaving the handle hard. Place the instrument for a few seconds on the pole piece or yoke of an electric motor or dynamo, while the machine is in motion; repeat this two or three times. Be careful and not let the instrument be sucked into the moving parts of the machine. The steel for the instrument should be a cheap and coarse-grained steel, that will harden well, and not fine-grained tool steel. The bulky handle acts as a storage for the magnetic energy. The magnetism will be retained in the handle for a long time and be fed to the point of the instrument in contact with the eye, and gather up any loose specks of iron or steel within its reach. When the instrument is used to dig out a piece imbedded in the eye, the magnetic attraction will help to loosen and pull it out.

J. LANDSING.

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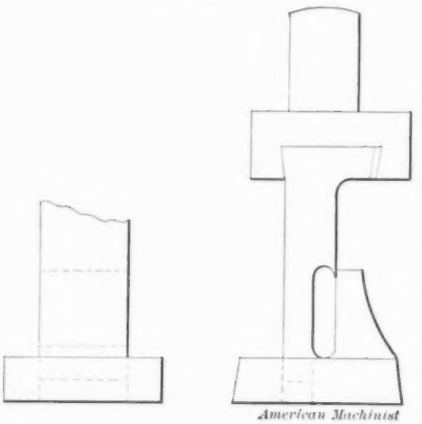
American Machinist

Tube-Forming Dies.

Editor American Machinist:

I would respectfully suggest that our friend Mr. Hardinge try the suggestion, for a tube-forming die, embodied in the accompanying sketch, in lieu of the one given in your issue of July 22d.

W. A. WARMAN.

Buffalo, N. Y.

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Is the Average Iron Molder Entirely to Blame for What He Don't Know?

Editor American Machinist:

The shafts of ridicule and censure which are so often hurled at the average iron molder, not only by machinists, but by his own craftsmen as well, are not well calculated to inspire him with the notion that he is a very important factor in the mechanical world.

That there are a great many so-called molders whose sun will never reach the meridian is not to be denied, but let us consider for a moment the conditions that produce him, and see if he is not the logical product of a pernicious system.

When as an apprentice he betrayed the fact that he had mistaken his calling, as is so often the case, he was not in mercy and justice told by the foreman to quit the foundry and try for something to which he might be adapted while yet young. While he is serving a stated time to learn the trade, what he learns or whether he learns anything at all is subordinate to the question of, on what work will he make the greatest pecuniary return to employer.

After he has "learned the trade"—pardon the derision—it is considered that he don't know much about it, at least the inducements offered him to remain suggest that. He decides to "strike out." If he does not depart from the teaching, "always be truthful," he will not get much higher if he roams from Maine to Texas. Wherever he goes, to his anxious application for a job, will come—when the prosperity wave gets here—the query, "Where have you been employed? What did you work on?" To the truthful answer, "At the great Wockowock Co.'s foundry, on grate-bars and flat-backs," will come the cheering reply, "We have got a year's work on them; come in to work in the morning." After he has worked a few years on such, his ambition may prompt him to ask for a chance to try a better class of work; then he is told, "No, we want a man who is used to that." Thus the "average molder" is developed. Is it a great wonder that he is unable to read nature's hieroglyphics as they appear upon the castings? After his long term in the academy of stern experience, Mr. R. D. Moore (in the "American Machinist" of July 8th) tells him of many things he don't know. I will plead guilty for him, and venture the assertion that when he finds it to be true that a shaft ten feet long does not require a feeder so large as one of same diameter two feet long, he will bloat to enormous dimensions with the notion that should its length be infinitely extended it would need no feeding at all. He don't know that he is consulted on the construction of cast-iron flask handles and it is not plain to him why he should be held accountable for them. Somehow he got the idea that those good, bad and abominable specimens were constructed to the order of someone somewhat above the average.

I will give him a sketch of a handle for iron flasks, which won't get hot, or break easily, so that he may acquit himself somewhat if he should be required to construct his own. Plain wrought iron rods will do for the purpose, and they can be put in or taken out any time. I hope the sketch is plain enough for him to grasp the idea without further explanation. Should the rods getting lost be considered an objection, I would suggest that he carry them in his hat, if he liked.

He isn't just clear on "why the shrink strain breaks a curved, and therefore

yielding pulley arm, easier than a straight, and therefore rigid arm." Perhaps he will be, contemporary with the machinist who centers pulleys from the outside, drives couplings on with a sledge, and files high-speed journals.

H. O'NEIL.

Dover, N. H.

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Making Tools for the Foundry—Gaggers.

Editor American Machinist:

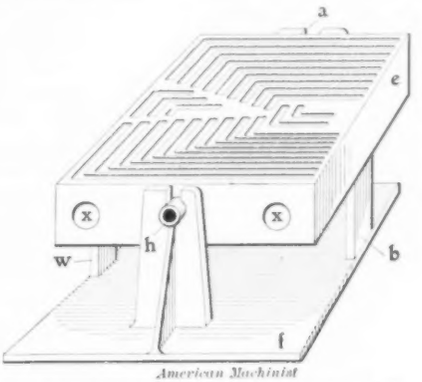
If there is one thing more than another that has caused profane language and bad feeling in the foundry, it is gaggers. There are some men that make it an object to get their own tools to work with. There are others that will not, but if their neighbors have of course they think that they are welcome to them, especially if the strongest; and taking it on an average the man that strives to get his own tools and wants to keep them has many enemies in the foundry. There are several foundries in the country that supply their molders with shovel, dry brush, bucket, rammer, and one or two riddles. But it does not matter, they will not take care of them, but would rather use those that belong to the next man. It seems to me that they must think that other people's tools are better than their own.

Some men make their own gaggers when they want them, consequently they have some left over sometimes; neighbors are not long in spying them, want to borrow, "will make some to-morrow sure, then will give them back," and so it goes.

But there is a good idea out now, I have seen it in several foundries and it is a first-rate thing to make gaggers in. By its use a common laborer can make about half a ton in the space of an hour. It is very simple and the pattern can be made in a very short time. Get a block of wood, say about 2 feet long, 3½ inches thick, 15 or 18 inches wide with trunnions on the end, 2½ inches diameter and about 3 inches long. Instead of mortising out the block for the patterns of the gaggers, get a piece of ¾ inch stuff, the size of the block and saw out the spaces. Do not nail it on the block, but put dowels in it as it will be better for the molder to finish it. If well spaced out a block of this size will hold about 21 gaggers, with ¾ inch space between them. Put the trunnions about 1 inch from the center of the block sideways. Make a stool to hold the block with bearings in the legs for the trunnions. The idea of having the trunnions out of center is that when the gaggers are cast, the man puts his foot on the block and turns it over, and it will strike on a short piece *a*, cast on the stool for the purpose of knocking out the gaggers; when the block is turned back again it rests on another piece on the other side of the stool *H'*. I saw one the other day, that had been in use for the last three years and there was not a crack in it. The chill will get hot of course if there are many to cast; but put a little oil on it with a piece of waste and then pour some water on it. When it is cool enough turn it over and let the water run off, it will dry itself.

Make the pattern and try it before casting it, then you can regulate the length of the stop blocks. It must be borne in mind that the chill rests on one of the blocks whichever way it stands. When the chill is ready for pouring, it rests on the back block, so that it will turn down at the front. A ⅛-inch draft can be put in the ¾-inch depth of the gaggers, so that there will be no trouble in getting these out when the chill is turned over.

A very good plan in connection with this would be to cast a pipe in the block, having the inlet and outlet at the trunnions marked *h* and *a* in the sketch, or a flat



American Machinist

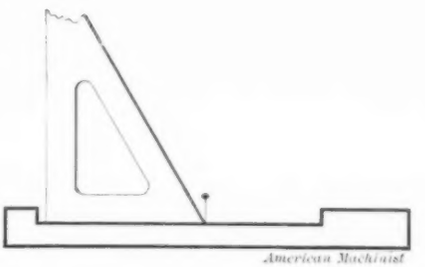
MAKING TOOLS FOR THE FOUNDRY.

core could be cast in it, with eight holes about 2 inches diameter through the core to hold the plates together. The holes marked *x* are openings for the purpose of getting out the core, they must be stopped up after the core is out. It will not need a stationary pipe for the water, as a common hose will do the business; put a valve at the inlet and outlet, turn on the water so as to keep the chill full, and regulate it with the outlet valve. In making the chill, I neglected to state that the casting could be made the same on both sides, without making two patterns of the gaggers proper. Put the chill pattern down on the follow board, ram it up and roll it over; now pull out the block and finish the bottom, pulling out the loose strip with the gaggers on. Now put back the block, then put the loose piece on top of the block; then ram up the cope, lift off and finish.

I do not claim to be the originator of the chill and stand, but I do of the water appliance and the two-sided chill, as it will save considerable time, since the man making the gaggers can use it all the time, instead of waiting for it to cool off. As the thickness of the chill will be about 4 inches, I would suggest that a core not over 1 inch thick be put in, and leave the metal on the sides about 1½ inches.

THOS. WATHEY.

Cleveland, O.


American Machinist

A Cheap Section Liner.

Editor American Machinist:

I have noticed several descriptions of section liners in your paper lately, but none as simple as that described below. The material needed is a smooth piece of wood, a trifle thicker than the blade of the T square, about a half an inch wide and long enough to project beyond the triangle at both sides, and if it is desirable to vary the spacing a pin stuck into the wood will be as efficient as anything. The sketch renders further description unnecessary. I am sorry I cannot claim design as my own and do not know who to credit it to.

DEE.

▲ ▲ ▲

A Motor Carriage Race.

During a recent motor carriage race in France fifty-nine vehicles took part, which included three motor bicycles, thirteen tricycles, eight voiturettes or quadricycles, thirty-five motor carriages with two to six places, and one car for nine passengers. Only one of the vehicles was a steam carriage. This belonged to the Comte de Dion, and had places for four passengers. Not a single competitor used electricity. The length of the actual race was 93¾ miles, though, as a matter of fact, the carriages actually covered a distance of 106¼ miles. The winner covered the distance of 93¾ miles in 4 hours 13 minutes and 33 seconds, which is at the rate of something more than 22 miles an hour—a record of road speed for this distance which, we think, must be considered highly creditable. The second in the race was the steam carriage of the Comte de Dion, which occupied 4 hours 16 minutes 34 seconds on the road. It carried four persons.

▲ ▲ ▲

It is announced that the Cramps, of Philadelphia, have brought suit in the Court of Claims against the United States to recover damages alleged to have been incurred by delays and defaults of the United States in furnishing armor plate and plans to be used in the construction of various battleships and cruisers. The aggregate amount of the claims is $1,736,149.

▲ ▲ ▲

Mr. E. Jones, chief engineer of Kynoch, Limited, Birmingham, England, is in this country to buy bicycle and gun-making machinery.

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Credit for Practice and Inventions.

Prof. Sweet's letter which we publish this week, raises a question as to what shall be the criterion in determining whether a given practice shall be called American or not. The question is much broader than this, however, and comes up more frequently in connection with inventions, and in both these directions our views are somewhat at variance with those commonly held. It can often be shown that some tool which is characteristic of American practice originated elsewhere, and on the strength of that showing it is easy to say that we have no right to call it American, and similarly some inventor is often found to have anticipated some modern invention years ago, and the later inventor is thereby denied credit for his work and in fact his patent rights may be declared invalid. We do not profess to enter upon the legal aspects of the case, but in morals and equity we believe the practice to be wrong. It is an old saying and very nearly a truthful one, that "there is nothing new under the sun," and inventors who have labored for years in perfecting and marketing some device, often find the fruits of their work denied them because of some old but stillborn invention, which, while it anticipated the idea, never was heard from outside the patent office records.

We believe that the man who gives an invention to the world and who forwards it to that point where the world may reap the benefits from it, is the man who is entitled to the credit of being considered its inventor. Prof. Sweet tells us that James Watt invented the Corliss valve, but if he saw so little advantage in that form of valve as to discard it, it seems to us the credit due to him is small, for the fact is the reverse of complimentary to his discernment and judgment. The same principle applies to the subject of boring mills and many others which might be named. We do not believe the boring mill is entitled to be called an English tool because one was made in England before any were made here. The undoubted fact is that the merits of the boring mill were first recognized by American tool builders, and it was consequently developed here and has come to be a characteristic and representative tool in American machine shops, and that we believe entitles it to be called American.

The link motion was undoubtedly used in the United States before it was used in England, but it was tried only to be discarded, its builders for some strange reason not appreciating its merits. Are we therefore entitled to claim the link motion as an American device? By no means. The merits of the device not being recognized and the gear being discarded until after its value had been demonstrated in England, is to our mind distinctly discreditable to American mechanics, and while the prior use of the link motion here is historically interesting, we think the fewer claims based on that fact the better.

To sum it all up, we believe that practice which is characteristic of American shops as distinguished from others and especially which has been developed and put into use—not invented—here, is entitled to be called American practice. The mere inventing of any device is the smallest part of bringing it before the world, and the idea that an inventor shall be denied credit for his work in bringing some device to the point of practice, because some mere scheme of past years foreshadowed it, is in our mind, lacking in the first elements of justice.

Our Foreign Trade and our Consular Service.

American machinery builders are becoming more and more vitally interested in the matter of securing an efficient consular service, and it would seem to be about time they did something more than merely bewail the fact that our consular service is not conducted upon business principles, and that we are, in far too many instances, represented abroad by men who have received their appointments by the working of a system which can by no possibility secure good men, except rarely and by fortuitous accident.

The tales that one hears in foreign cities regarding the incompetence and the general worthlessness of many of our foreign consuls are calculated to make an American blush with shame, and it is disgraceful that we must continue to be commercially injured by our totally senseless practice of sending new men every four years to look after our commercial and other interests in foreign cities; men who know nothing of commerce or of our manufactures, usually, or at least often, know nothing of the language or the business and social usages of the countries to which they go, and who, assuming that they have the mental capacity and the disposition to learn these, are sent home and replaced by other ignoramuses directly they have learned them. Our practice in this matter violates every rule of common sense and of business procedure. We select these men with a total disregard of fitness and solely upon political grounds. That is to say, a certain man has done certain work for the party, has secured so many delegates to a convention, or has been a part of some political machine, the tool of some local boss, and for this is rewarded by a foreign consulship. The fact that he has done such work is almost positive evidence of his unfitness for the position of United States consul, but nevertheless a place must be made for him. So, in order that he may be sent abroad to misrepresent America, someone else, perhaps better fitted by nature, but in any event with some experience of the duties of the position, is recalled. It were better a thousand times over to pay such men twice the salary they receive and keep them at home doing nothing, or at least where, when they do anything, it will not be as the representatives of this country and before people who are not able to make the proper allowances for them.

Our method of managing this matter is in strong contrast to that of other nations, and our consular service is the laughing-stock of Europe. We do not know whether the present administration is doing a little better or a little worse than its predecessors in this matter, but it is certainly not doing much different, and instances can be given in which good and efficient men who by some fortunate accident have been occupying consular

places, have been displaced to make room for political heelers possessing absolutely no qualifications whatever.

This is one of the many things which we would do well to consider in the light of the practice and experience of other nations who do them better than we; it being a well-known fact, for instance, that Germany's recent rapid development of foreign trade has been very greatly assisted by her efficient consular service. Germany's consular service is composed of well-trained men, who know that so long as they perform their duties well, the permanence of their positions is assured.

We have occasionally had and now have, some good men representing us in foreign cities; but they are simply the exceptional cases wherein there was no candidate for their particular positions whose "pull" had to be recognized, and every one of them knows that good service rendered will not alone secure permanent tenure.

Is it not time that the machinery and other manufacturing interests of the country, who will in all probability be more and more dependent for assistance upon our consular service, made themselves heard in this matter, and in some decisive manner?

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American Electrical Machinery in England.

The fact that the Central London Railway is to be equipped with machinery made in America continues to be commented upon, and there are a great many persons in England who are apparently considerably exercised about it, and it is reported that Parliament has actually adopted a resolution of censure. We confess, however, that we cannot see how those who are responsible for giving out this contract could have done otherwise than be guided by plain business principles in a matter of so much importance, and these are precisely what they seem to have been guided by. It is well-known that very great obstacles have been placed in the way of the development of electric traction in England, and some of these obstacles, Parliament itself is chiefly, if not wholly responsible for. As it is to be expected that the art of electric traction will be more highly developed in a country where its development has been much freer, the result is natural that electric traction has been carried considerably further here than in England, and that the manufacture of the apparatus involved in electric traction has been much more highly perfected here. Any large enterprise can do little else than avail itself of that experience and buy where it can buy to the best advantage.

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We should discriminate somewhat in our use of slang. An American machinery man in England cabled to know if a certain order would be accepted, and the answer was "nit," which led certain Englishmen into a long and fruitless search through telegraph code books to find the meaning of "nit."

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(124) J. L., New York, and others, ask for information regarding the responsibility and reliability of the Institute for the Home Study of Engineering, of Cleveland, O. A.—Our readers are aware of the interest which we feel in the system of correspondence instruction, as applied to mechanical subjects. Owing to this and to the importance of the matter to many of our readers, we have made such an investigation of the matter as circumstances permitted before answering the question. We have obtained copies of the instruction papers and of some of the work by the students, with replies thereto by the instructors, and have also communicated with several students of the school. The impression formed is favorable—the mathematical work especially impressing us as being of a very common sense nature, while the work of the instructors appears to be done conscientiously and thoroughly. The students of the school also speak well of it. Of course any examination of this kind is of necessity somewhat superficial, but so far as we judge the school is entitled to confidence.

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Personal.

Passed Assistant Engineer M. B. Bevington, U. S. N., is ordered to the Bureau of Steam Engineering.

Chief Engineer H. N. Stevenson, U. S. N., is detached from the Bath Iron Works and ordered to Monterey.

A. L. De Leeuw, who has been with the Pond Machine Tool Co. for some time past, has made an engagement as designing engineer with the Niles Tool Works.

Mr. Alfred Bache, who has been secretary of the Institution of Mechanical Engineers (England), for over 43 years, retired recently on account of failing health, and was unanimously voted a gratuity of $15,000 in recognition of his long and valuable services to the institution.

Mr. O. H. Fernbach, who was formerly connected with the Western Electric Company, has gone to Japan, having received an appointment by the Japanese Government to supervise the construction of a trolley line which will be the first of any importance near Tokio.

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Franz Kustner, Kaiserstasse 9, Dresden, Germany, wishes quotations on two and a half million bicycle chain blocks, sawed smooth and bored from drawn steel rods 18 x 8 mm., blocks to be 6 mm. thick, holes 5 mm. diameter, and 10 mm. center to center distance, straight, true, smooth at right angles with flat face of blocks. The holes must be countersunk at each end ½ mm., and the blocks are to be hardened, but not blued.

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Technical Books.

THE ENGINEER'S SKETCH-BOOK OF MECHANICAL MOVEMENTS, DEVICES, ETC. By Thomas Walter Barber, engineer. Spon & Chamberlain, 12 Cortlandt street, New York.

This is the third and an enlarged edition of a book which every inventor and designing engineer finds use for. It contains 2,603 illustrations of devices or means of accomplishing different mechanical movements, and there are descriptive notes and memoranda. These are carefully classified for convenient reference. Three hundred and thirty-five 8½ x 5-inch pages. Cloth, $4.

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Manufacturing Methods as Applied to the Production of Machinery.*

BY F. A. HALSEY.

Maintaining dimensions and expediting work comprise essentially the whole purpose of organized manufacturing methods as distinguished from the older methods. The purpose of what follows is to point out some of the means by which these objects are attained; but it is obvious at the start that no single industry, and certainly no single lecture, can adequately illustrate such a subject. The methods to be described relate more especially to manufacture by the aid of special fixtures, rather than by special machines, and refer to pure machine-shop operations only.

At the foundation of any system of manufacture is the system of measurements employed. If the workmanship of the product is to be common, then the methods of measurement may be common, but as the grade of workmanship advances so must the methods of measurement be more refined; for, contrary to a very common—in fact, to an almost vulgar — impression, interchangeability and good workmanship are not synonymous; in fact, so far as they have any related meaning, they are rather the opposite of synonymous. The fact of interchangeability tells very little regarding quality of workmanship, but what little it does tell is negative. Interchangeable machines may be poor, common, fair, good or even excellent, but superfine, never; for the best workmanship in machines is not, and, in my opinion, never will be, interchangeable. For example, it is a safe assertion that fine measuring machines and dividing engines will never be so made. Many who ought to know better, will talk as though because a certain machine is made interchangeably, it is therefore, and by that token, marvel-

* Introductory portion of a lecture before the mechanical engineering students of Cornell University.

ously well made; whereas, in point of fact, the one thing of which we are certain about it is, that it is nothing of the kind. Interchangeability is, in fact, in many instances, a concession as regards workmanship to other and more important considerations; those considerations being the cheapening of the product and the facilitating of repairs. In our case the second reason is paramount. Rock drills go into remote sections, their duty is terrific, and they are subject to rapid wear. Facilities for doing machine work at mines are often very meagre, and it is of leading importance that the parts supplied to replace those worn and broken shall fit; in fact, I know of no industry in which the necessity of interchangeability for its own sake is so great as here. Usually, however, the facilitating of repairs is a purely secondary consideration. Machines are usually made by interchangeable methods, because it is cheaper to so make them.

At the beginning of any consideration of the question of measurements, we find the division of line and end measures. Line measures are, of couse, the chief reliance in making machinery by the older methods; while end measures, in some form, are a necessity if interchangeability is to be secured, and in this lies the broadest single distinction between the two methods of manufacture. In fact, the necessity for end measures in connection with the interchangeable methods, is largely the reason for the development of the whole subject of refined measurements.

THE FIRST STANDARD CALIPER GAGE.

Because the workman cannot produce interchangeable work when supplied with ordinary line measures, while he can do it if supplied with end measures, it is therefore commonly assumed that line measures are inferior to end measures; but this is true only as related to the methods commonly employed in using them. The most accurate work done, that of manufacturing standard gages, depends, and must depend, upon the use of line measures, although in such use they are of course surrounded with highly refined appliances. It will thus be seen that in accuracy attainable, line measures occupy the two extreme positions. The reason for the gagemaker's reliance upon line measures lies, of course, in the fact that end measures wear by use.

In this connection it becomes of immediate importance to know the limits of accuracy obtainable by different methods. The best test which I have ever seen recorded regarding the accuracy of line measures when used in the ordinary methods of the shop, was made by Mr. Miller, editor-in-chief of the "American Machinist," who is himself an expert workman. Mr. Miller turned up five plugs, of different sizes, to necessitate independent setting of the calipers for each piece, and after they were finished he measured them with a Brown & Sharpe micrometer caliper. Within the limits discernable by that instrument, one piece was exact. The errors in the others ranged up to an extreme of 1½ thousandths of an inch, the entire range between the smallest and the largest being 2½ thousandths. These results are no doubt better than could ordinarily be obtained; but it is probable that a good workman supplied with good tools can maintain his sizes within about 2 one-thousandths of an inch; some of the pieces being small and others large, so that the entire range would be about 4 one-thousandths of an inch.

If a workman be given a plug instead of a scale, and be asked to reproduce it, his errors will, of course, come far within this limit. Anyone who has any experience in the use of calipers can detect, with the greatest ease, differences in the size of two plugs of a ten-thousandth of an inch; while an expert workman can probably detect differences as minute as the forty-thousandth of an inch, so that a common pair of calipers, considered as an instrument of comparison only, is fairly entitled to be called an instrument of precision.*

It is this great facility for reproducing sizes in this way which led to the introduction of the Whitworth plug and ring gages; the idea being that these gages should be isued to the workman, and that he should simply reproduce their diameters by the aid of his calipers, instead of taking the sizes from a graduated scale. Plug gages are frequently used directly, especially in small sizes, but ring gages are not well adapted to direct use. The fact that these gages can be reproduced so accurately implies at once that they can be compared with equal accuracy, and the gagemaker is thus compelled to maintain his sizes within very narrow limits, and it is for this reason that gages are made to such an extraordinary degree of accuracy, and not because of any real requirement of the workshop. The very term "standard gage" implies that the errors shall be so minute as to be beyond detection by the ordinary methods of the shop, especially when, as usual, those methods can detect minute errors but cannot determine their magnitudes. The Whitworth plugs and rings could not stand this test, a fact which is attributed, by those best informed, to the reliance in their manufacture upon end measures.

Other methods of introducing end measures in the shop are seen in the Brown & Sharpe vernier and micrometer calipers, both of which are essentially combined calipers and scales, since they are line measures so far as the reading and adjustment are concerned, but end measures so far as gaging pieces is concerned. Another development in this direction is the production of solid caliper gages, the idea being that these tools shall be made to fixed sizes, and shall be issued to the workmen for direct use in place of calipers. These gages have two defects, one growing out of the fact that they are too stiff, and the other out of the fact that they are not stiff enough. In consequence of the former, they do not give the workmen as much warning as the piece approaches size as spring calipers do, and in consequence of the latter, they can be crowded over a piece while still too large; so that a workman will often say that a piece is gage size when, in fact, the gage has been sprung over the piece. This fact of the deflection of apparently stiff pieces of the metals of construction whenever they have any provocation, is a very difficult one to thoroughly learn.

In the history of caliper gages the Sibley College shop has played a very honorable part. So far as is known, Professor Sweet was the first to conceive the idea of making these gages,* and whether he was the first to conceive the idea or not, he was undoubtedly first to endeavor to put it into execution. The 12-inch measuring machine which is still in use here was made with that purpose in view, and, it is proper to add, was made chiefly

* Mr. Viel, of the Brown & Sharpe Manufacturing Company, states that with the B & S. measuring machine differences of .0001 inch can be detected by the sense of touch alone

* Home-made caliper gages have, of course, been made for a long period. The statement in the text refers to standard instruments intended as an article of manufacture and sale

by the hands of John Waterman, of '77.* Some gages were also made, and of these you see before you the very first. This gage is not only the first of its kind, but it and the measuring machine from which its size was originated, represent the beginning of accurate measurements in this country. The measuring machine is of remarkable merit as well as of great historical interest. Its solution of some of the problems connected with this work are, in my opinion, final. The lineal descendant of this machine is the small measuring machine or large micrometer caliper which goes by Professor Sweet's name, and this instrument furnishes, in my opinion, the cheapest, and in many respects the best, means of introducing standard measures into a shop, especially if it be of moderate dimensions. The instrument reads to half-thousandths only, a degree of accuracy which is not sufficient for gage making, if the gages are to be subjected to critical comparison; but the remarks already made regarding the accuracy of gages will show why a measuring machine which is not accurate enough for gage work may still be abundantly accurate for construction work. The machine is, in effect, a universal caliper gage, and is the foundation of our shop. We especially make use of it in maintaining the size of a great number of reamers and other boring tools. These† are so arranged that, when dull, they may be enlarged, and then are reground to the old size by setting the measuring machine in accordance with a record kept in a book for that purpose—many of our dimensions being not standard, from the continuance of old errors. Another great advantage of this method of measurement over that of the caliper gages, lies in the fact that very often the even dimension is not wanted. A journal must be smaller than the bearing in which it turns, while a shaft which is to be forced into a crank must be larger than the bore of the latter. By the aid of this machine all such matters are easily reducable to order and system—a thing which is impossible with caliper gages alone.

Another instrument of great usefulness which is not adequately appreciated, is the indicating caliper,‡ which performs the function of an ordinary caliper, with the addition that it shows how much too large or too small a piece may be, while the common caliper simply shows the fact of whether the piece is large or small, without giving the amount. As the measuring machine performs the function of a universal caliper gage, so the indicating caliper performs the function of a universal limit gage. It is also of great usefulness in connection with the grinding machine, as it enables the piece of work to be watched as it approaches size, giving in all cases the amount of metal remaining to come off.

Another method which we use, and which is very valuable where an economical outfit is essential, lies in the use of standard or sample pieces for final reference standards. In a great number of cases these pieces supply the place of a much more expensive set of gages.

Regarding limits which have been referred to, it is not often that in work which is to be cut, like milling-machine and turret lathe work, the total range of variation can be reduced below two one-thousandths of an inch, and it is very seldom that it can be reduced below one one-thousandth. In work which can be finished on the grinding machine, these limits can be very much reduced. There are three methods of using limits. In the first, the plug is made to size or smaller, while the hole is made to size or larger. By this method the largest plug will, of course, enter the smallest hole, but the fits will vary in different cases. By the second method the range of variation in plug and hole, after allowance has been made for oil, in the case of a bearing, is substantially between the same limits. When this method is followed, the largest plug will not enter the smallest hole, and absolute interchangeability is lost. This is provided for in the assembling by selecting pieces to fit, the result being that the average fits are better than in the first case, a condition which illustrates the statement already made that, to a certain extent, interchangeability and good workmanship are antagonistic. In most manufactories where really good work is done more or less selection is done. The third method is employed on such pieces as are capable of being produced by the grinding machine. This machine gives great facility for producing work, within limits, which, for practical purposes may be called exact, in consequence of which the plugs are made to practically standard size, and the entire range of variation is thrown upon the hole. Where the hole can also be ground, both plug and hole are made within very narrow limits. Of course, all three methods may be employed on different parts of the same machine. This matter of limits is one in which enthusiasm is very expensive. The cost of keeping up the tools and of adjusting the machine increases very rapidly as the limit is cut down, perhaps as rapidly as the inverse square, and good judgment must be employed in deciding upon the limit to be used.

(Concluded next week.)

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The defective engineering of a coal-bin plunged the city of Paterson, N. J., in darkness on Saturday evening last, and left the trolley cars helpless in the streets. The plant of the Edison Electric and Illuminating Company at Paterson is considered one of the best in the United States. Nevertheless a thousand tons of coal took a slide, breaking steam pipes and demoralizing the boilers, and at this writing chaos still reigns.

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Commercial Review.

NEW YORK, Saturday Evening, August 14.

THE ENGINE MARKET.

That general business is on the mend, is the opinion of a large proportion of the writers upon the subject, and that this sentiment is genuine is evidenced by the buoyancy of the stock market. Still, there may be need of timely advice to "go slow," for we have had examples of manufactured booms in the not remote past, and the present one, if really substantial, will be able to take care of itself, in spite of a little conservatism in its heralding.

The market for steam power machinery, which is our topic of consideration this week, has not, as yet, been very greatly affected by the favorable change in surrounding conditions, although the field is not without some apparent results of these. An idea exists, however, that trade will be better in the autumn, and the manufacturers' agents are hanging on their oars, waiting for the incoming tide of business to reach the upper stream of the market.

It appears as if the engine builders had harder work to hold their own than the electrical machinery manufacturers. Competition is keen enough in the dynamo and motor market; but from the relative number of electrical companies and engine concerns, it is no wonder if the pie of the latter has to be cut into smaller pieces. It might be said that the application of engines is more extensive than that of dynamos, and, hence, that there is a greater field for their sale; but this is far less true than it used to be, and it seems as if almost every engine now sold was intended to run a dynamo; although, of course, it is not all types of engines which are designed for this kind of work. The statement is made, however, that for the proposed equipment of the Arbuckle Sugar Refinery, in Brooklyn, N. Y., eight engine concerns submitted bids, and as many as ten electrical houses. It was not known, yesterday, at the New York office of the engine company which is most likely to secure this contract, whether it had yet been placed, if, indeed, it is certain that it is to be, at some time. For the steam pump equipment of this plant it is said the purpose has been to divide the order between two or more makers. The pump contract for the New York Sugar Refining Company was placed a short time since.

Export trade in engines does not appear to be much brisker than usual, although there is said to be considerable doing in estimates for future work. One seller speaks of Mexico as about the best field

* Deceased.

† Shown later. The solid reamer has no proper place in manufacturing operations.

‡ Shown on the screen.

at present; another turns his attention to Europe and Japan.

IT HAS BECOME A GRIEVANCE

that manufacturers frequently allow far greater discounts for export than they do at home. For instance, an export contract for an engine and dynamo was recently to be placed, and a bid was put in to furnish a Corliss engine, with a dynamo figured upon at little or no profit to the engine people, for the purpose of completing the contract. Whereupon, the dynamo builders sold the same to an export commission house at two-thirds the price at which they had offered it to the Corliss engine people. Consequently, the latter lost the contract, and an engine of another make was secured to accompany the dynamo.

REPORTS FROM A FEW LEADING CONCERNS.

The Lidgerwood Manufacturing Company are at present running full time, and with nearly full force, and feel that the situation is gradually improving. On the day we communicated with them, orders happened to come in for three engines for this country and one large one for export.

McIntosh, Seymour & Co. report a degree of activity which in these times is certainly exceptional. They have been rushed with work for a year and a half, and are running night and day. Among the engine work now on hand is 1,200 horse-power for the Edison Electric Light Company, of New York, and 3,500 horse-power for that of Brooklyn. Three engines, aggregating 400 kilowatts, have also been ordered for an isolated lighting plant in the latter city.

The Edward P. Allis Company, who have already received some large export orders, and have helped to rouse the wrath of the British Parliament, are apparently flourishing, and are figuring on some further important foreign work.

The Abendroth & Root Manufacturing Company, boiler builders, report: "Business has decidedly improved in this country. Waiting contracts have been closed up. The sources of some of our recent orders have been Philadelphia, Cincinnati, Michigan. One has also come from Spain."

The Frick Company inform us that although there is a fairly good engine business this year, their attention has been principally taken up with ice machinery, in which their business has hardly ever before been so good.

ELECTRIC RAILWAY WORK.

Some work for both engine and dynamo builders may come in the future from the Shor Electric Company, which has secured franchises at Shrewsbury, N. J., and purposes to indulge in lighting and railway enterprises. Another proposed engine

(*Continued on page 37.*)

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

For brass castings write H. D. Phelps, Ansonia, Ct.

Machine Shop Equipm'ts. York & Co, Clev'd, O.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Engine Castings ½ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Gear and milling cutters, adjust. reamers, counterbars and tools, vert. millers, drill pr., cutter and surf. grind., shears. R M. Clough, New Haven, Ct.

Cost of Manufacturing—Experienced manager will establish system of costs, giving exact account of every detail. Charge based on saving effected. Correspondence solicited. Geo. C. Thomas, 99 Nassau Street, New York, Room 212.

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Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Prac. toolmkr. & dftmen. wants wk. 124, Am. Mach.

Mech. en., exp. sup. & head dr. Box 156, Am. Mach.

Machinery designer, 6 years best exp., technical graduate, moderate wages. Box 148, Am. Mach.

Exp. foreman, toolmaker and designer in large bicycle works, desires change. Box 145, Am Mach.

Experienced, all-round mech. draftsman, desires position; moderate salary. Box 154, Amer. Mach.

Wanted—Position by draftsman, 6 yrs. exp., tech. edu., N. Y. or Brooklyn pref. P. D. Q., Am. Mach.

Machinist, young man, gen. mach., sober, comp., steady, wants pos.; ref. H. Beck, Bellefonte, Pa.

A mech. eng., grad., with 18 months' exp., desires position; salary moderate. Box 117, Am. Machinist.

Mech. draftsman, tech. grad, 6 years exp. wants a posi. Steam engines, coal and ore handling mach. Competent to take charge of office. 129, Am. Mach.

Young man, grad. M. E., some shop exp., supt. 4 yrs. dur'g develop and mfr. of smokeless powder, desires posi., preferably in experimental and testing dept. Box 137, American Machinist.

Sit. Wanted—Screw tool mkr. 25 yrs. exp., 9 yrs. of that time cont. in one of largest gun and bicycle fact in U. S. Ball bearings and all work on bicycle made on screw mach. a specialty 133, Am. Mach.

First-class patternmaker desires position in charge; extensive practical experience in large green sand and loam work. Salary moderate at start. Good draftsman. Box 131, Amer. Machinist.

Experienced draftsman, and designer of automatic engines and special machinery, seeks employment; thorough mech.; handle men to advantage; good business knowledge. Box 157, Amer. Mach.

The supt. of a prom. mfg. institu. des. a change; can organize a factory and handle men to good advantage; thor. familiar with the des. and mfr. of bicycles; member of A.S.M.E. Box 147, Am. Mach.

Machinist, engineer and draughtsman on fine tools and small mach'y is open for eng'm't. 15 years as forem'n and supt. Accurate at costs and estim's. G. W. N., No. 44 Montgomery ave., Alleg eny, Pa.

Mechanical engineer (31) desires change; tech. edu.; good, responsible exp., steam and general mach.; competent to act as chief draftsman, engineer or manager's assistant. Box 155, Am. Mach.

Responsible position wanted by M. E.; twenty years in the business; either as superintendent, charge of drawing room or designer. Would travel for some good house. Best of references guaranteed. Box 150, American Machinist.

Wanted—To change position as foreman machinist, tool maker or instructor in manual training school by a thorough and practical machinist and tool maker; seven years' experience as foreman; good execut'e ability; A1 ref. Box 144, Am. Mach.

Situation wanted by practical mechanic and millwright of experience in factory where much hand work is required for making, handling and packing goods, to devise and construct new and improved machinery to do same work; general repairing; best references. Edwards, Box 770, Brooklyn, N. Y.

Situation Wanted—I am at present superintendent of a manufacturing plant making a line of special automatic tin can machinery. I can invent and design special automatic machinery for any purpose. I wish to make a change and solicit correspondence with parties wishing to employ talent in the mechanical line. I am also an expert mechanical draftsman, and would accept position as head drafsman. Will make reasonable terms for a year's contract. Address Box 149, Amer. Mach.

Help Wanted.

Agents in ev'y shop for "Which Way" Levels. Sell on sight. Write at once to E. G. Smith, Columbia, Pa.

Superintendent, with manufacturing experience in typewriter, sewing machine, clock or similar lines; good salary to first-class man. Address, giving references, Box 153, American Machinist.

Wanted—Mechanical engineer of large experience, competent to take charge of drafting department in an establishment building Corliss engines and employing several hundred men. Refenc. and record of services req. Add. Box 151, Am. Mach.

Able and energetic mechanic, thoroughly experienced in building machines for working light sheet metals, presses, shears, dies, etc., to take the lead in factory. Must be willing to spend part of the time on the road going after orders. Experience in handling help required. Rare chance for the right man. Address offers, stating experience and giving references, to "Sheet Metal," care of The American Machinist.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Patent right, special tools and machines for sale; good article to manufacture with other machinery. Box 146, American Machinist.

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

Wanted to lease from parties a small equipped machine shop and foundry, or machine shop alone, suitable for mfr. of gas eng. and pumping mchry.; steam and power. Ad. C. M. M., Box 83, Canton, O.

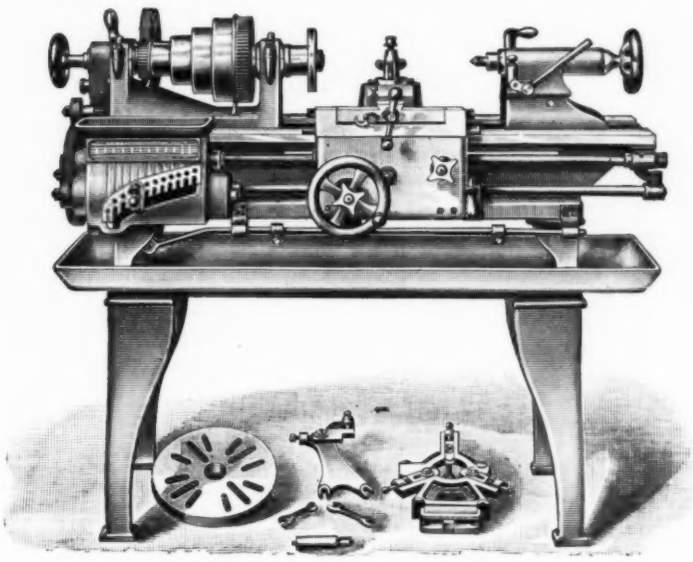
After years' study and experiment with shaft-governor automatic engines I desire to interest some capital in the re-ults attained, which are superior to present productions; invite investig'n from proper parties. Governor, care Am. Mach.

Wanted Capital, $10,000—A one-half interest in an established machine tool company is offered a practical man having the executive ability to conduct the business. Strictly modern shop and equipment with ample orders. Address Box 49, American Machinist.

A machine shop, with modern equipment, heavy and light machinery, cranes of 20 tons capacity and 10,000 square feet of unoccupied floor space, would contract to manufacture any kind of machinery. Parties already having machinery built under contract might do well to write us for estimates. Box 62, American Machinist.

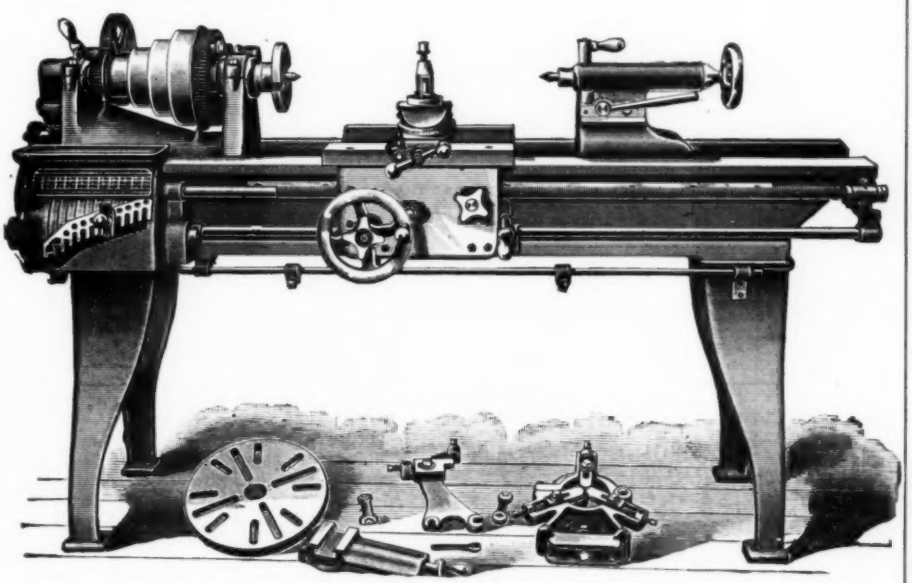
One of the first machine tool factories of Germany wants the agency of a first-class American tool factory for Germany or the whole Continent. This factory sustains the best of relations to all the leading industrial works in Germany, as well as abroad, and can bid fair prospects of good business. Address Box 132, American Machinist.

No better location to competent parties to re-establish a job machine shop and foundry, to replace one burned, and firm bankrupted two years ago, which for 50 years had employed from 15 to 20 hands; a portion of the patterns and foundry fixtures were saved. Capital of from $1 000 to $2,000 will be required for additional machinery and a cupola for foundry; rent can be paid in work; the finest villages and best shipping facilities in the Mohawk Valley. J. A. Cross, Fultonville, N. Y.



12" Hendey-Norton Lathe

is fitted with drawing-in sleeve and American Watch Tool Co's standard chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterwards. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.



14" x 6' Hendey-Norton Lathe.

These lathes are modern, high-grade, practical tools, and are specially adapted for tool-room work. They have the Norton Attachment for screw cutting, giving 36 different threads and 36 different feeds with only two changes of gear and movement of lever in gear-box from one notch to the other. Note the automatic stop under apron. It will automatically stop carriage at any desired point in either direction; invaluable for internal or duplicate work. SEND FOR CATALOGUE.

The Hendey Machine Company,
Torrington, Conn.

Agents for the Pacific Coast, Pacific Tool & Supply Co., San Francisco, Cal.

European Agents: Chas. Churchill & Co., London and Birmingham, Eng.; Schuchardt & Schutte, Berlin and Vienna; Eugen Soller, Basel, Switzerland.

(*Continued from page 36.*)

installation, for street railway purposes, is at Chambersburg, Pa.; but it is uncertain whether it will ever be carried out.

An electric railway in Wisconsin has contracted to install two Weston engines of 450 horse-power each.

EXPORTS OF MACHINERY.

The Monthly Summary of Finance and Commerce, of the United States Treasury Department, shows, for June, 1897, that among domestic merchandise exported, machinery of all kinds amounted to $2,611,787, as compared with $1,857,003 for June, 1896. For May, 1897, the figures were $2,710,706. For the fiscal year ending June, 1897, the total was $29,444,317, against $21,614,430 for the fiscal year previous.

Quotations.

NEW YORK, Monday, August 16.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 50 @ $12 00
No. 2 foundry, Northern	10 25 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	9 75 @ 10 00
No. 1 foundry, Southern	10 50 @ 10 75
No. 2 foundry, Southern	10 00 @ 10 25
No. 3 foundry, Southern	9 75 @ 10 00
No. 1 soft, Southern	10 50 @ 10 75
No. 2 soft, Southern	— @ 10 50
Foundry forge, or No. 4, South'n	9 50 @ 9 75

Barn Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.05c.; refined, 1.05 @ 1.15c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.45c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some grades perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45c.

Cold Rolled Steel Shafting—Base size, in small lots, from store, 2 @ 2¼c.

Copper—Carload lots, Lake Superior ingot, 11¼ @ 11¼c.; electrolytic, 10⅞ @ 11⅛c.; casting copper, 10¾ @ 10⅞c.

Pig Lead—Carload lots, 3.85 @ 3.90c., f. o. b.

Pig Tin—For 5 and 10-ton lots, about 14.10c., f. o. b.

Spelter—Carload lots, New York delivery, 4.30 @ 4.35c., f. o. b.

Antimony—The range, according to brand and quantity, is 7 @ 8c.

Lard Oil—Prime city, winter make, commercial quality, in wholesale lots, 37½ @ 38c.

▲ ▲ ▲

New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

We have received from the Duplex Printing Press Company, Battle Creek, Mich., a catalog in which is illustrated and described the "Duplex" printing press. The catalog is tastefully gotten up, and contains a number of testimonial letters from various printing and publishing houses, and is 7¾ x 10¾ inches.

The Clayton Air Compressor Company, of New York, have issued catalog No. 9, which is descriptive of single and duplex air compressors, a detailed account of the various parts being given. The catalog is 6¼ x 9½ inches, and will be forwarded to those interested upon application.

We have received from Israel H. Johnson, Jr., & Co., Philadelphia, Pa., a catalog illustrating and describing machine tools, including lathes, punches, shears, etc. The lathes described are of various styles. The catalog is of large standard size, 9 x 12 inches, and at the end some useful information for those engaged in running lathes is given.

Manufactures.

At Canton, Me., T. Percy Cole is fitting up a machine shop.

At Red Lake Falls, Minn., Potts & Newton are to erect a sawmill.

At Council, Que., the Quebec Central Railway expect to erect shops.

At Oreland, Pa., an addition is being erected to the mill of Sasman Bros.

At Florence, Col., the Kilton Company are to erect a reduction works.

At Wheeling, W. Va., the La Belle Company are erecting a new tin mill.

At Birmingham, Ala., The Bidwell Metallic Tie Company will erect a factory.

At Barnum, Tex., fire recently destroyed the planing mill of W. T. Carter & Bro.

At Marysville, Mont., Thomas Cruse is preparing to erect a new reduction works.

The East Lebanon Iron Company, at Lebanon, Pa., are erecting a new building.

At Taunton, Mass., the Carr Manufacturing Company are to erect a new cotton mill.

At Philadelphia, Pa., the F. A. Poth Brewing Company are to erect a new building.

At Hutchinson, Kan., the Michigan Salt Association are to erect a manufacturing plant.

At Belmont, Mass., Sylvester Tower is contemplating the erection of a piano-key factory.

At Morris, Minn., S. Stewart is erecting an elevator to replace the one recently destroyed by fire.

At Galveston, Tex., the Griffin & Barnes Machinery Company has been formed; capital, $10,000.

At St. Hyacinthe, Que., Canada, the tannery of Mr. Frank Moseley was recently destroyed by fire.

The Newark (O.) Weldless Tube & Steel Company are to erect a new rolling mill, 90 x 160 feet.

The Jackson Woolen Mills, Jackson, Tenn., recently destroyed by fire, it is rumored, will be rebuilt.

At Philadelphia, Pa., the National Essence of Coffee Company are to erect an addition to their plant.

At Webster, Mass., J. W. Bishop has been given the contract for an addition to the Slater mill.

At Harwood, Pa., A. Pardee & Co. are to erect a new building, the contract for which has been let.

The Novelty Glass Works at Washington, Pa., destroyed by fire some time ago, are being reconstructed.

At Kentmere, Del., James Bancroft & Sons' Company have just completed the erection of their new mill.

It is probable that the Belle Plain Mine Company may erect a new mill in the near future at Gillett, Col.

At Fulton, Va., the Millhiser Manufacturing Company are preparing to build an addition to their establishment.

At South Elizabeth, N. J., the John Stephenson Car Company will soon commence the construction of its new plant.

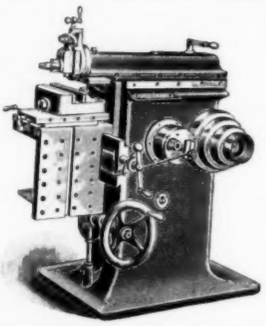
The town of Scranton, Miss., are considering the placing of a water works and electric-light system for the town.

Rambo & Regar are to have erected at Norristown, Pa., a hosiery mill. It will be 46 x 196 feet, and four stories high.

The Hernsheim Architectural Iron Works, of New York City, has been incorporated to manufacture ornamental iron work.

The Deane Steam Pump Company, of

(Continued on page 39.)



9 and 14-inch Pillar Shapers

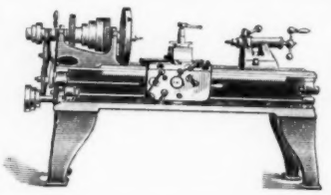
Uniform Cutting Stroke, Quick Return, Automatic Cross Feed in either direction. Work fast and accurately. Newell Vise and Countershaft with each.

Prices, NET, - - 9-inch, $300. 14-inch, $350.

9 and 14-inch Crank Shapers, all feeds automatic, Tool Making Lathes, Drills, Millers, Die Sinkers. Ask for the Machinists' Catalogue.

THE PRATT & WHITNEY, COMPANY,
HARTFORD, CONN., U. S. A.

New York, 123 Liberty St. Boston, 281 Franklin St. Chicago, 42 South Clinton St. London, Eng., Buck & Hickman, 280 Whitechapel Road. Paris, France, Fenwick Freres & Co., 21 Rue Martel.



FOR SALE—FOUR second-hand 15-inch swing Engine Lathes, 6-foot bed, taking 40-inch between centers.

These are tools of our own make, in thoroughly first-class condition, warranted to be as good as new. They take a two-inch belt, have 1 5-16 hole through Spindle, large steel spindles running in bronze bearings, Screw, rod and power cross feeds. Cut all standard threads from 5 to 36, have large and small face plates, steady and follower rests; steel rack, deep and strong beds, and they are accurate and true in construction.

We will put these lathes F. O. B. cars here at $150 each net cash, or with compound rest for $162 net. These are bargains. Satisfaction guaranteed. Address for further information

SEBASTIAN LATHE COMPANY,
117 and 119 Culvert Street, Cincinnati, O.

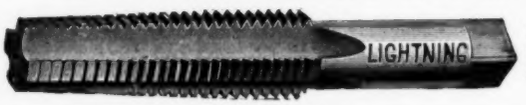
NOW READY.

ELECTRIC RAILWAYS AND TRAMWAYS
THEIR CONSTRUCTION AND OPERATION.

A PRACTICAL HANDBOOK by PHILIP DAWSON, C. E. 530 Figures, 183 Tables, 705 Pages, Demi-quarto, Half Morocco. **$12 50.**

JOHN WILEY & SONS, Scientific Publishers, 53 East Tenth Street, New York City.

FINE MACHINE RELIEVED TAPS OF EVERY DESCRIPTION.



"Lightning" and "Green River" Brands of Screw Plates, Dies, Reamers, Tap Wrenches, Bolt Cutters, Drilling Machines, etc.

SEND FOR CATALOGUE.

WILEY & RUSSELL MFG. Co., Greenfield, Mass., U. S. A.

Agents in London, SELIG, SONNENTHAL & CO., 85 Queen Victoria Street.

DYER & DRISCOLL,
PATENT SOLICITORS, 31 NASSAU STREET, N. Y.

Have done all my patent soliciting work, both for this and foreign countries, continuously for the past fourteen years.

Thomas A. Edison

STAR LATHES.

★ ★ ★

Foot Power Screw Cutting, Automatic Cross Feed, 9 and 11' Swing.

Send for Catalog B.

Seneca Falls Mfg. Co.
687 Water St., Seneca Falls, N.Y.

'96 THE NEW '96 JENKINS '96

IS the Perfection of Joint Packing. Instantaneous, **Does Not Squeeze Out** and not necessary to follow up joint. We guarantee it to last for years on any and all pressures of steam or any kind of joint where packing is required. Does not rot, burn or blow out, therefore the best for all purposes. Call for and insist on having **'96 JENKINS '96,** stamped like cut. . . . . .

JENKINS BROS., New York, Boston, Phila., Chicago.

Die and Tool Steel.

NO BETTER MADE.

CRESCENT STEEL CO.

PITTSBURGH, PA.
CHICAGO, ILL.
NEW YORK, N. Y.
DENVER, COL.

Steam & Gas Engine Castings

Both Stationary and Marine.
Dynamo and Motor Parts and Complete Machines.
Electrical Supplies, Telephones.
Send Stamp for Catalog.

MIANUS ELEC. CO., Box A. Mianus, Conn.

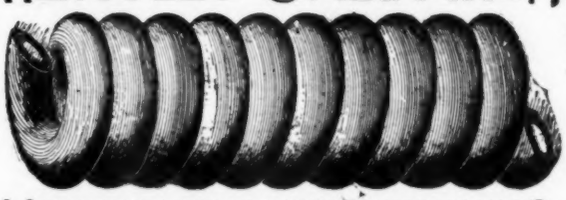
PURDUE UNIVERSITY,
LAFAYETTE, INDIANA.

Courses in
MECHANICAL ENGINEERING,
ELECTRICAL ENGINEERING,
CIVIL ENGINEERING.

Extensive Laboratories. Fine Equipments.

Catalogue sent on application.

HERCULES COMBINATION



Leaves the stem clean

Write for Testimonials.

Patented and Manufactured Exclusively by

PEERLESS RUBBER MFG. CO.

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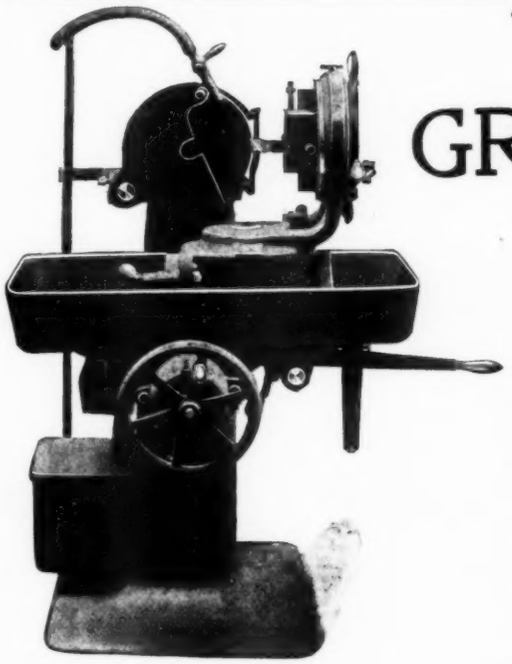
16-24 Woodward Av., Detroit, Mich.
202-210 S. Water St., Chicago, Ill.

METALLIC STOP VALVE PACKING



TOOL GRINDING

on the "Gisholt" is an exact science—all tools of the same class are alike—one man does all the grinding for 150 machines.

GRINDSTONE

tool grinding by each man in shop is one of the greatest sources of waste in machine shops.

This machine helps keep all other machines at work more hours per day, insures uniform tool grinding and dressing.

Saves steel and stops "pet" grinding by Tom, Dick and Harry, to the delay and detriment of the work.

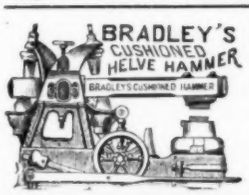
COSTS ONLY $200.

Let us send you a catalog that shows forms of tools and tells how to keep up standards easy.

Gisholt Machine Co.

AGENTS:
Eastern Branch, 126 Liberty St., New York.
Walter H. Foster, Manager.
U. Baird Machinery Co., Pittsburgh, Pa.
C. W. Burton, Griffiths & Co., 158 Queen Victoria St., London, E. C., England.
Fenwick Freres & Co., 21 Rue Martel, Paris, France.
Schuchardt & Schütte, Spandauer Strasse 59-61, Berlin, C., Germany.
Schuchardt & Schütte, Breitegasse 17, Vienna, VII, Austria.
Selig, Sonnenthal & Co., London.

Madison, Wis., U.S.A.



BRADLEY HAMMERS

THE BEST POWER HAMMERS ON EARTH.

22 sizes in Helve, Upright and Strap Styles.

Send for Printed Matter.

The Bradley Company
Syracuse, N. Y.

AUTOMATIC FRICTION CLUTCH CO.

CATALOG ON REQUEST.
821 STATE STREET,
ERIE, PA.

(Continued from page 38.)

Holyoke, Mass., are cramped for room, and probably an addition will be erected.

The Nazareth Manufacturing Company, Nazareth, Pa., are to erect an addition, which will be equipped with new machinery.

The Platte Valley Sugar Company, of Schuyler, Neb., has been incorporated, and at Schuyler a new factory is to be constructed.

At St. Cloud, Minn., the mill of the St. Cloud Lumber Company has been destroyed by fire. The damage was estimated at $60,000.

At Richmond, N. S., Messrs. Hillis & Sons are building a new foundry, and it is expected the works will be in operation early in the fall.

Mayor Jones, Toledo, O., and E. Side are interested in the erection of a factory to engage in the manufacture of tools used in the oil fields.

At Montgomery, Ala., the round-house and machine shops of the Western Railroad were recently destroyed by fire. The damage is estimated at about $100,000.

At Kalamazoo, Mich., the machine shops of William E. Hill & Co. were destroyed by fire. The machinery was very much damaged, and the loss reaches about $13,000.

At Cheshire, Mass., H. C. Bowen & Son will rebuild their mill on the site of that which was burned some weeks ago. The machinery installed will be of an improved class.

The Boston & Montana Consolidated Mining Company, it is stated, will in a short time start up the Moose mine, Butte, Mont. Larger machinery will be installed in the plant.

The Summit Foundry Company has been incorporated with a capital of $35,000. The directors of the company are William Reid, Roger Hogan and Joseph F. Quay, of Geneva, N. Y.

The Champion Silk Company has purchased the plant of the Bannockburn Textile Works at Pottstown, Pa., and will start up a new silk mill, for which purpose new machinery will be installed.

At New Haven, Conn., the Lenox Knitting Company has been organized by Messrs. Adolph Mendel and Isador Freedman. The company has leased a factory, which will be equipped with new machinery.

The Potomac Hydraulic Cement Company, of Keedysville, Md., has been incorporated by Henry A. Jones, Washington; Joseph A. Blundon and others. The chief office of the company will be at Antietam, Md.

At Middletown, Conn., the Doebler & Leonard Company has been reorganized, and Pettingill Bros., of Rockville, have assumed charge. The company manufactures shears, drops, metal cutting machinery, etc., and will at once resume operations.

The Ogdensburg State Hospital are remodelling their entire power plant. They will install four Watertown engines, direct-connected to six Walker generators. The old apparatus is all to be removed.

The Structural Iron Company of Baltimore, Md., are to erect a new plant, which will be devoted to the manufacture of roofs, trusses, bridges, etc. The plant will be equipped with modern machinery, and will have within its confines pattern and molding shops.

The Watertown (N. Y.) Steam Engine Company have just installed two Cross compound vertical high-speed engines, direct-connected to Westinghouse generators, in the Twenty-third Street Ferry House of the Pennsylvania Railroad Company, and are now building four engines of 600 horse-power, direct-connected to General Electric generators for the Carnegie Music Hall.

A Drama of Real Life.

IN TWO ACTS.

• • •

ACT I.

SCENE—The office of the proprietor of a large machinery-building establishment The proprietor, Mr. Wiseman, sitting at his desk, opening and reading letters—some from customers claiming rebates on various flimsy pretexts, others with checks discounting 2 per cent. "for cash" on bills 90 days overdue. Office boys bringing in cards of advertising agents by the dozen. Enter Mr. Jawsmith, of the "Machinery Manufacturers' Friend and Advertisers' Adorer."

Mr. J'smith—Good morning, Mr. Wiseman. I hope you are quite well and that you find business improving. Did you receive those orders I sent in to you last week? (Washes his hands with invisible soap.) I tell you what! I am going to send some business your way, now that I am a little over the rush. You know very few people would think of buying machinery without first consulting us, and we can just as well turn some of that business your way. You know I——

Mr. W.—Well now, my friend, I don't wish to have any misunderstanding about this matter or to be under obligation to you for business. If you really secure business for us, I shall take pleasure in allowing you the regular commission on that business, but I prefer you to understand at once that the matter of advertising in the "Machinery Manufacturers' Friend" and what-do-you-call-it is another matter. I know perfectly well from the character of the matter published in that paper that not 100 sane men could be found to subscribe and pay for it. Its circulation must, in the nature of things, be gratuitous—same as it comes here every week. We may as well understand each other at once and come down to business. I will pay the usual commissions on orders, but will not advertise in any journal unless convinced that the advertising space purchased is itself worth the price charged for it. And in my opinion no advertising space can be worth anything except in a paper which publishes original matter of the kind that interests machinery men—the men I want to reach. Talk about "orders" will not rub out these hard facts, and I prefer to do business on business principles.

[*Exit J'smith.*

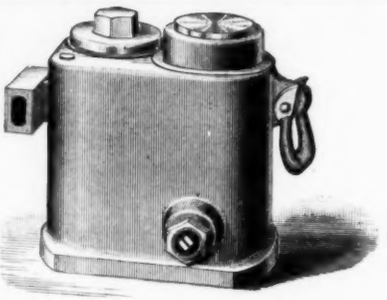
ACT II.

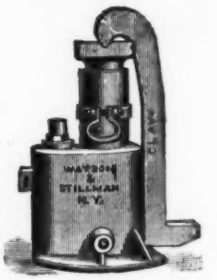
Ten minutes are supposed to have elapsed. Scene same. Enter "American Machinist" Representative.

A. M. R.—Good morning, Mr. Wiseman. A year ago to-day you signed an advertising contract with us which we hope you have found satisfactory and which we would be pleased to have you renew—and it might be well to consider at this time our new 500 inch contract. It offers some special advantages for people who have things to sell worth advertising and know how to use the space.

Mr. Wiseman—I have an appointment to meet in ten minutes—but let me see that contract you speak of. (Reads. Signs.)

[CURTAIN.]





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All Sizes, All Shapes, of All Lifting Powers. Smallest to Largest.

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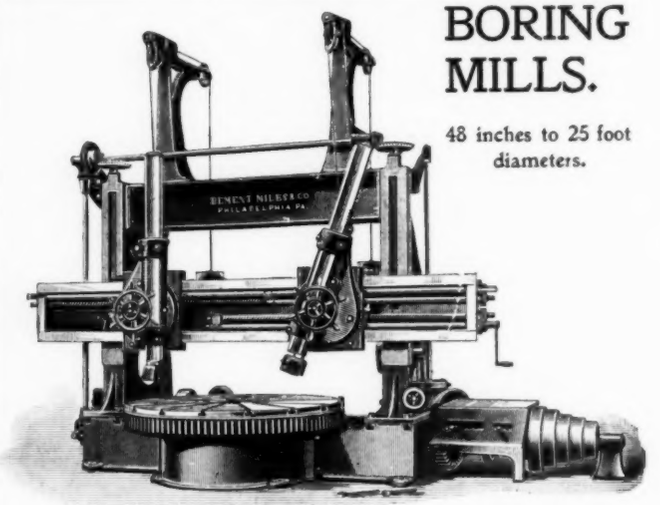
NEW YORK.

Ask for Catalog "D."



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48 inches to 25 foot diameters.

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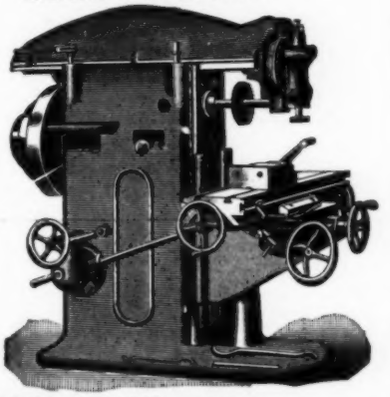

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Pope Mfg. Co., Hartford, Conn.

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Bardons & Oliver, Cleveland, O.
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Garvin Machine Co., New York, N. Y.
Geometric Drill Co., New Haven, Conn.
Hendey Machine Co., Torrington, Conn.
Kempsmith Machine Tool Co., Milwaukee, Wis.
McCabe, J. J., New York.
Wells Bros. & Co., Greenfield, Mass.
Woodward & Rogers, Hartford, Conn.

BICYCLE TUBING.
Pope Tube Co., Hartford, Conn.

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American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Roots Co., P. H. & F. M., Connersville, Ind.

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National Tube Works, McKeesport, Pa.

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Webster & Perks Tool Co., Springfield, O.
Wells Bros. & Co., Greenfield, Mass.

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Comstock, Wm. T., New York.
Wiley & Sons, John, New York.

BORING AND TURNING MILLS.
Betts Machine Co., Wilmington, Del.
Bickford, H., Lakeport, N. H.
Bickford Drill & Tool Co., Cincinnati, O.
Bullard Machine Tool Co., Bridgeport, Conn.
Niles Tool Works Co., Hamilton, O.

BORING MACHINES.
Beaman & Smith, Providence, R. I.
Betts Machine Co., Wilmington, Del.
Newark Machine Tool Works, Newark, N. J.

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Nolte Brass Co., Springfield, O.

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New Process Raw Hide Co., Syracuse, N. Y.

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Carborundum Co., Niagara Falls, N. Y.

CARBORUNDUM, CLOTH & PAPER.
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Mianus Electric Co., Mianus, Conn.

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Horton & Son Co., E., Windsor Locks, Conn.
Skinner Chuck Co., New Britain, Conn.

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Pawling & Harnischfeger, Milwaukee, Wis.
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Sellers & Co., Inc., Wm., Philadelphia, Pa.

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Betts Machine Co., Wilmington, Del.
Blundell & Co., Henry, Providence, R. I.
Dallett & Co., Thos. H., Philadelphia, Pa.
Davis & Egan Mch. Tool Co., Cincinnati, O.
Dietz, Schumacher & Boye, Cincinnati O.
Dwight Slate Machine Co., Hartford, Conn.
Foote, Barker & Co., Cleveland, O.
Ganz, Wm. E. & Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
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Norton & Jones Machine Tool Works, Plainville, Conn.
Prentice Bros., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sibley & Ware, South Bend, Ind.
Snyder, J. E., Worcester, Mass.
Stover Novelty Works, Freeport, Ill.
Timolat, J. G., New York.

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Morse Twist Drill & Machine Co., New Bedford, Mass.
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Watkins Co., F. W., Cincinnati, O.
Weber Gas and Gasoline Engine Co., Kansas City, Mo.
Webster Manufacturing Co., Chicago, Ill.
Wolverine Motor Works, Grand Rapids, Mich.

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Forbes & Co., W. D., Hoboken, N. J.
Frick Co., The, Waynesboro, Pa.
Norton, W. D., Cincinnati, O.
Toomey, Frank, Philadelphia, Pa.

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Tight Joint Co., New York.

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Buffalo Forge Co., Buffalo, N. Y.

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Evans Friction Cone Co., Boston, Mass.

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American Gas Furnace Co., New York.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Rogers' John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Wyke & Co., J., East Boston, Mass.

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Brainard Milling Machine Co., Boston, Mass.
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Bultman & Co., F. H., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Starrett & Co., L. S., Athol, Mass.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.

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Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston Mass.
Shriver & Co., T., New York.

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Dixon Crucible Co., Joseph, Jersey City, N. J.

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Builders Iron Foundry, Providence, R. I.
Diamond Machine Co., Providence, R. I.
Webster & Perks Tool Co., Springfield, O.

GRINDERS, CENTER.

Barker & Co., William, Cincinnati, O.

GRINDING MACHINE, CUTTER.

Cincinnati Milling Machine Co., Cincinnati, O.

GRINDING MACHINE, UNIVERSAL.

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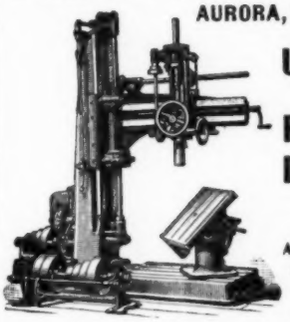

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Mitts & Merrill, Saginaw, Mich.

LATHES (see also Turret Lathes).

Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith, Providence, R. I.
Bement, Miles & Co., Philadelphia, Pa.
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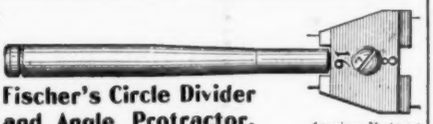

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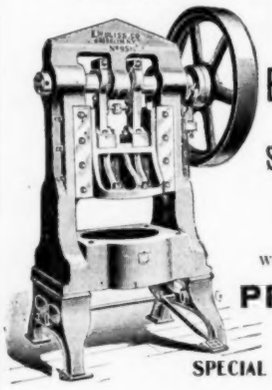

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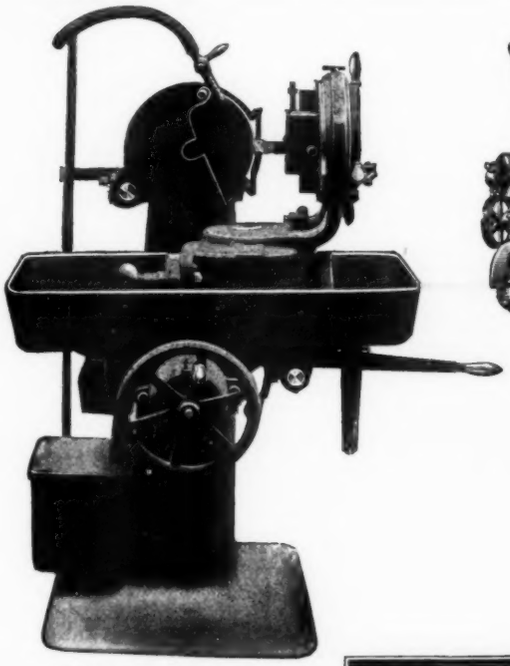

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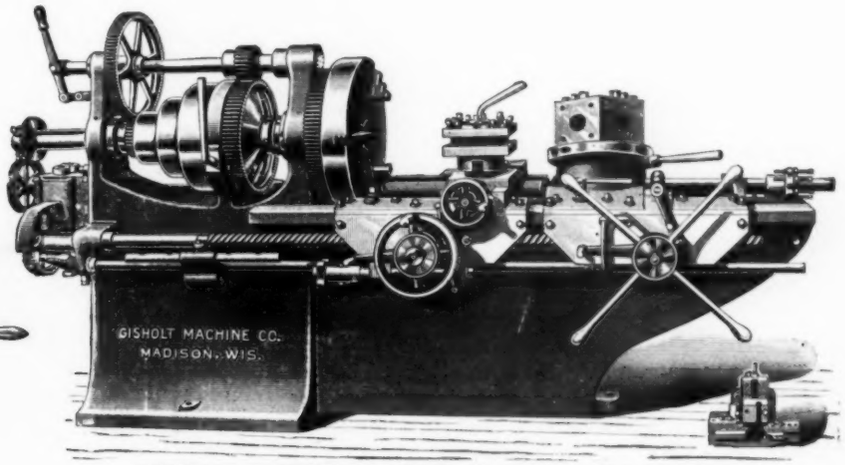

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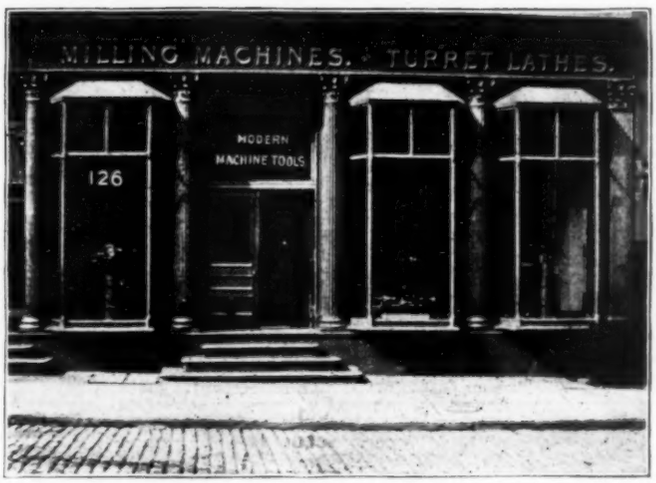

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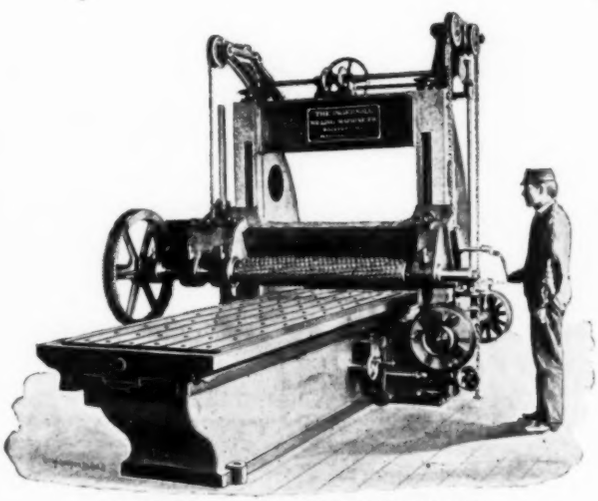

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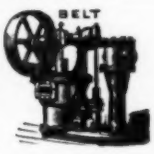

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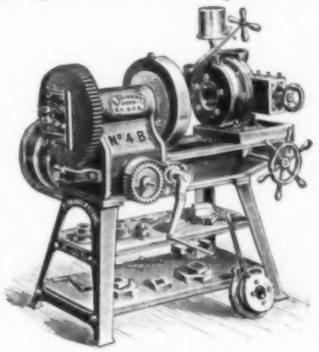

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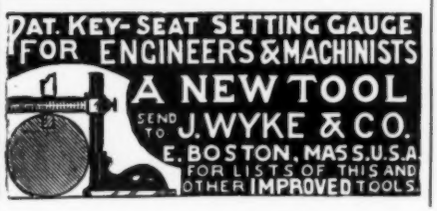
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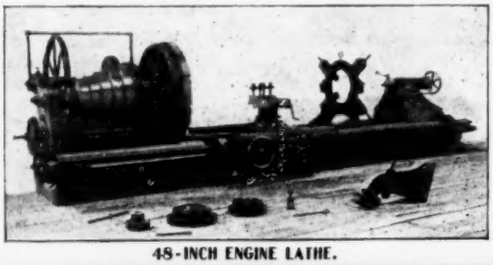

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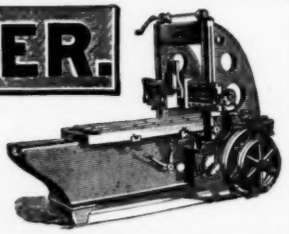

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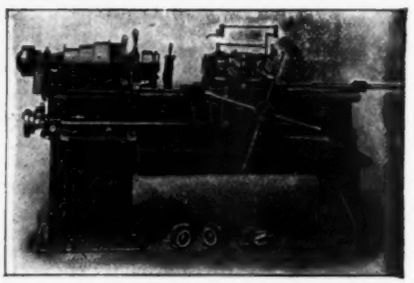

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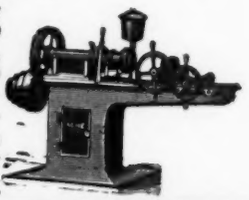

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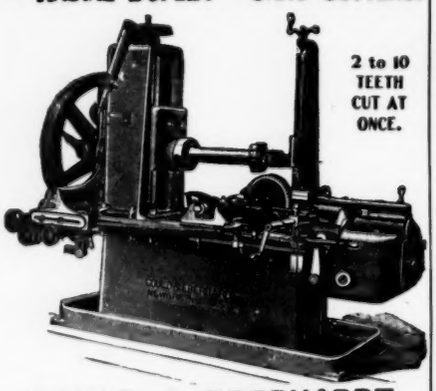

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